VS1MD User Manual

6/07 Instruction Manual MN760-3

The information in this manual is subject to change without notice.

Safety Notice

This equipment contains voltages that may be as high as 1000 volts! Electrical shock can cause serious or fatal injury. Only qualified personnel should attempt the start-up procedure or troubleshoot this equipment.

This equipment may be connected to other machines that have rotating parts or parts that are driven by this equipment. Improper use can cause serious or fatal injury. Only qualified personnel should attempt the start-up procedure or troubleshoot this equipment.

Precautions: Classifications of cautionary statements

WARNING: Indicates a potentially hazardous situation which, if not avoided, could result in injury or death.

CAUTION: Indicates a potentially hazardous situation which, if not avoided, could result in damage to property.

Precautions

WARNING: Do not touch any circuit board, power device or electrical connection before you first ensure that power has been disconnected and there is no high voltage present from this equipment or other equipment to which it is connected. Electrical shock can cause serious or fatal injury. Only qualified personnel should attempt the start-up procedure or troubleshoot this equipment.

WARNING: Do not touch any circuit board, power device or electrical connection before you first ensure that power has been disconnected and there is no high voltage present from this equipment or other equipment to which it is connected. Electrical shock can cause serious or fatal injury. Only qualified personnel should attempt the start-up procedure or troubleshoot this equipment.

WARNING: Be sure that you are completely familiar with the safe operation of this equipment. This equipment may be connected to other machines that have rotating parts or parts that are controlled by this equipment. Improper use can cause serious or fatal injury. Only qualified personnel should attempt the start-up procedure or troubleshoot this equipment.

WARNING: Do not use motor overload relays with an automatic reset feature. These are dangerous since the process may injure someone if a sudden or unexpected automatic restart occurs. If manual reset relays are not available, disable the automatic restart feature using external control wiring.

WARNING: Do not use motor overload relays with an automatic reset feature. These are dangerous since the process may injure someone if a sudden or unexpected automatic restart occurs. If manual reset relays are not available, disable the automatic restart feature using external control wiring.

WARNING: This unit has an automatic restart feature that will start the motor whenever input power is applied and a RUN (FWD or REV) command is issued. If an automatic restart of the motor could cause injury to personnel, the automatic restart feature of the VS1MSD should be disabled.

WARNING: Be sure the system is properly grounded before applying power. Do not apply AC power before you ensure that all grounding instructions have been followed. Electrical shock can cause serious or fatal injury.

WARNING: Do not remove cover for at least five (5) minutes after AC power is disconnected to allow capacitors to discharge. Dangerous voltages are present inside the equipment. Electrical shock can cause serious or fatal injury.

WARNING: Improper operation of control may cause violent motion of the motor shaft and driven equipment. Be certain that unexpected motor shaft movement will not cause injury to personnel or damage to equipment. Certain failure modes of the control can produce peak torque of several times the rated motor torque.

WARNING: Motor circuit may have high voltage present whenever AC power is applied, even when motor is not rotating. Electrical shock can cause serious or fatal injury.

WARNING: Dynamic brake resistors may generate enough heat to ignite combustible materials. Keep all combustible materials and flammable vapors away from brake resistors.

WARNING: The motor shaft will rotate during the touting procedure. Be certain that unexpected motor shaft movement will not cause injury to personnel or damage to equipment.

CAUTION: Disconnect motor leads (U, V & W) from control before you perform a “Megger” test on the motor. Failure to disconnect motor from the control will result in extensive damage to the control. The control is tested at the factory for high voltage / leakage resistance as part of Underwriter Laboratory requirements.

CAUTION: Suitable for use on a circuit capable of delivering not more than the RMS symmetrical short circuit amperes listed here at rated voltage.

Horsepower	RMS Symmetrical Ampheres
1-30	5,000

CAUTION: Do not connect AC power to the Motor terminals U, V and W. Connecting AC power to these terminals may result in damage to the control.

CAUTION: Baldor recommends not to use "Grounded Leg Delta" transformer power leads that may create ground loops. Instead, we recommend using a four wire Wye.

CAUTION: Only Baldor cables should be used to connect the keypad and control. These are special cables to protect the control and keypad. Damage associated with other cable types are not covered by the Baldor warranty.

CAUTION: If an M-Contactor is installed, the control must be disabled for at least 200msec before the M-Contactor is opened. If the M-Contactor is opened while the control is supplying voltage and current to the motor, the control may be damaged. Before the control is enabled, the M-Contactor must be closed for at least 200msec.

CAUTION: Use of power correction capacitors on the output of the drive can result in erratic operation of the motor, nuisance tripping, and/or permanent damage to the drive. Remove power correction capacitors before proceeding. Failure to observe this precaution could result in damage to, or destruction of, the equipment.

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CHAPTER 1
Introduction

This manual is intended for qualified electrical personnel familiar with installing, programming, and maintaining AC Drives.

This manual contains information on:

- Installing and wiring the VS1MD drive
- Programming the drive
- Troubleshooting the drive

1.1 Getting Assistance from Baldor

For technical assistance, call 1-864-284-5444. Before calling, please review the troubleshooting section of this manual and check the Baldor Drives website at www.reliance.com/vsdrives for additional information. When you call technical support, you will be asked for the drive model number or catalog number and this instruction manual number.

CHAPTER 2
General Information and Ratings

The VS1MD is a variable frequency PWM drive capable of operating in open-loop, volts-per-hertz mode and in a sensorless vector control (SVC) mode.

This chapter contains information about the VS1MD drive, including how to identify the drive.

2.1 Identifying the Drive by Model Number

Each drive can be identified by its model number, as shown in figure 2.1. The model number is on the shipping label and the drive nameplate. The model number includes the drive and any options.

Drive model numbers for the VS1MD drive are provided in table 2.1.

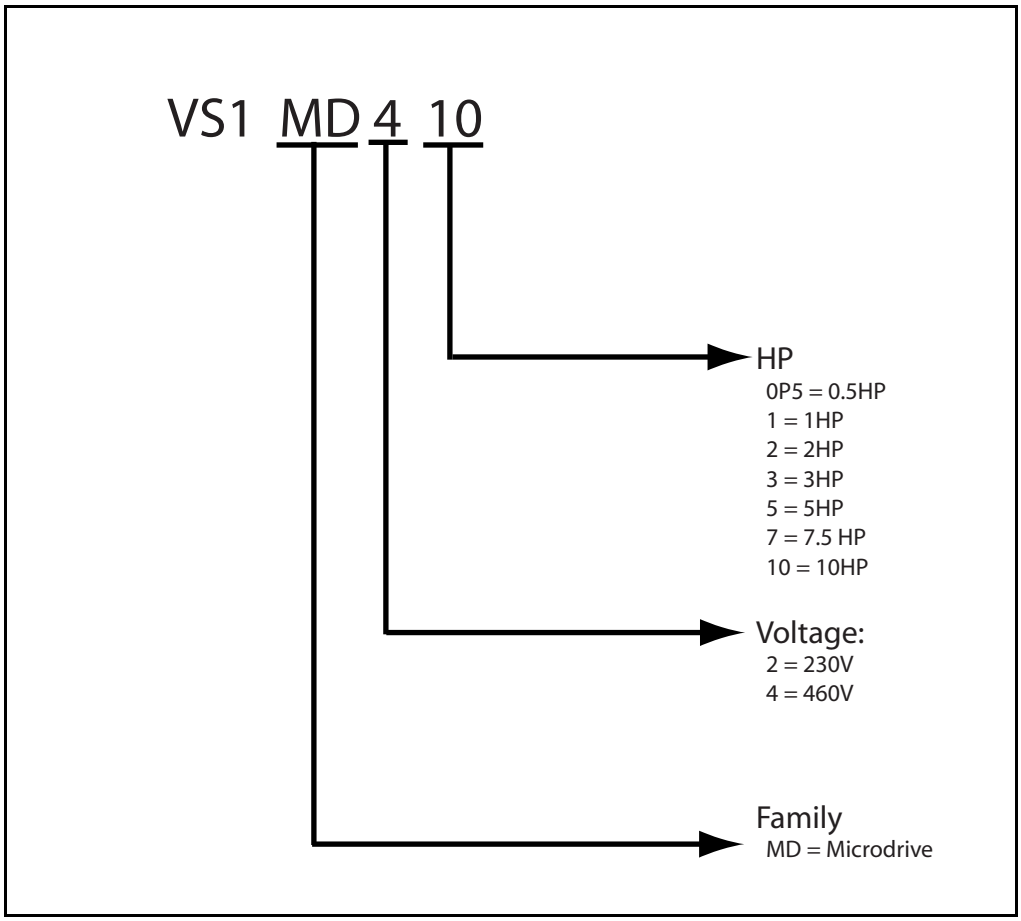


Figure 2.1 – Identifying the Drive by Model Number

2.2 VS1MD Drive Ratings, Model Numbers and Frame Sizes

Similar VS1MD drive sizes are grouped into frame sizes to simplify re-ordering and dimensioning. Refer to figures 3.2 through 3.5 for the dimensions of each frame size.

Table 2.1 provides VS1MD drive ratings, model numbers and frame sizes.

Table 2.1 – Drive Ratings, Model Numbers and Frame Sizes

Drive Ratings				Model Number	Frame Size
Input Voltage	kW	HP	Output Current		
200-230V 3-Phase	0.4	0.5	2.5	VS1MD20P5	A
	0.75	1.0	4.5	VS1MD21	A
	1.5	2.0	8.0	VS1MD22	B
	2.2	3.0	12.0	VS1MD23	C
	3.7	5.0	17.0	VS1MD25	C
	5.5	7.5	24.0	VS1MD27	D
	7.5	10	32.0	VS1MD210	D
380-480V 3-Phase	0.4	0.5	1.25	VS1MD40P5	A
	0.75	1.0	2.5	VS1MD41	A
	1.5	2.0	4.0	VS1MD42	B
	2.2	3.0	6.0	VS1MD43	C
	3.7	5.0	8.0	VS1MD45	C
	5.5	7.5	12.0	VS1MD47	D
	7.5	10.0	16.0	VS1MD410	D

2.3 Storage Guidelines

If you need to store the drive, follow these recommendations to prolong drive life and performance:

- Store the drive within an ambient temperature range of -40^{o} to +70 C^{o}.
- Store the drive within a relative humidity range of 0% to 90%, non-condensing.

Do not expose the drive to a corrosive atmosphere.

CHAPTER 3
Installing the Drive

This chapter provides information that must be considered when planning a VS1MD drive installation and provides drive mounting information and installation site requirements.

ATTENTION: Only qualified electical personnel familiar with the construction and operation of this equipment and the hazards involved should install, adjust, operate, or service this equipment. Read and understand this manual and other applicable manuals in their entirety before proceeding. Failure to observe this precaution could result in severe bodily injury or loss of life.

ATTENTION: Use of power correction capacitors on the output of the drive can result in erratic operation of the motor, nuisance tripping, and/or permanent damage to the drive. Remove power correction capacitors before proceeding. Failure to observe this precaution could result in damage to, or destruction of, the equipment.

ATTENTION: The user is responsible for conforming with all applicable local, national, and international codes. Failure to observe this precaution could result in damage to, or destruction of, the equipment.

3.1 General Requirements for the Installation Site

It is important to properly plan before installing a VS1MD to ensure that the drive's environment and operating conditions are satisfactory.

The area behind the drive must be kept clear of all control and power wiring. Power connections may create electromagnetic fields that may interfere with control wiring or components when run in close proximity to the drive.

Read the recommendations in the following sections before continuing with the drive installation.

3.1.1 Operating Conditions

Before deciding on an installation site, consider the following guidelines:

- Protect the cooling fan by avoiding dust or metallic particles.
- Do not expose the drive to a corrosive atmosphere.
- Protect the drive from moisture and direct sunlight.
- Verify that the drive location will meet the environmental conditions specified in table 3.1.

Table 3.1 – Ambient Temperatures and Mounting Clearances

Ambient Temperature		Enclosure Rating	Minimum Mounting Clearances
Minimum	Maximum		
-10^{o} C (14^{o} F)	50^{o} C (122^{o} F)	IP20/Open Type	5 cm
	40^{o} C (104^{o} F)	IP20/NEMA 1	5 cm
	50^{o} C (122^{o} F)	Side-by-Side	5 cm

3.1.2 Minimum Mounting Clearances

Refer to figure 3.1 for the minimum mounting clearances. Refer to section 3.1 for drive mounting dimensions.

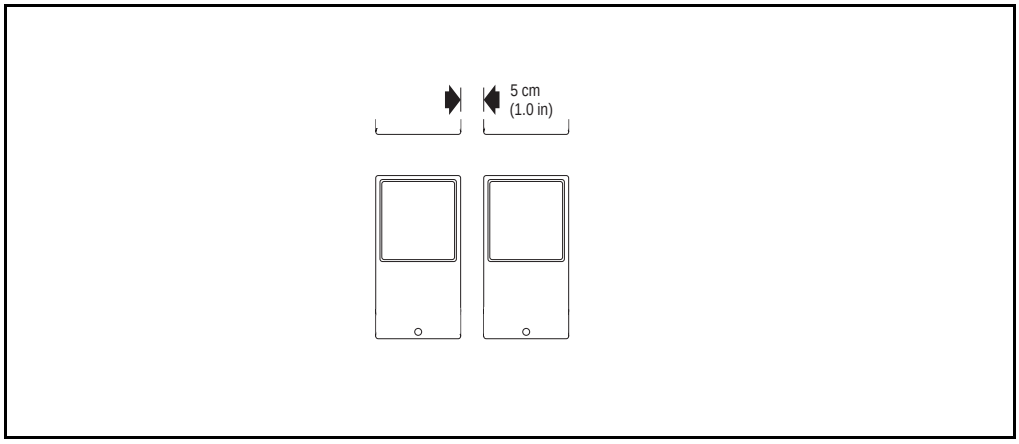
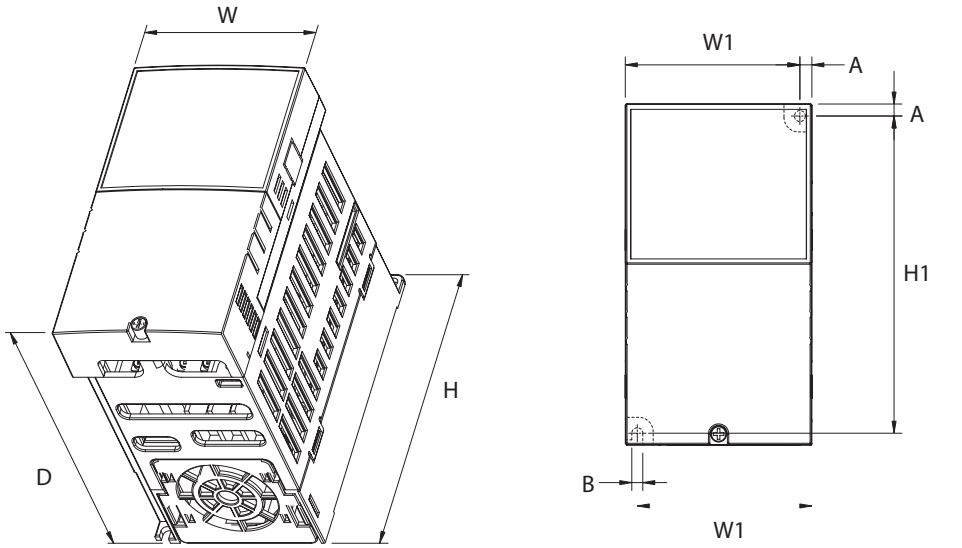


Figure 3.1 – Minimum Mounting Clearances

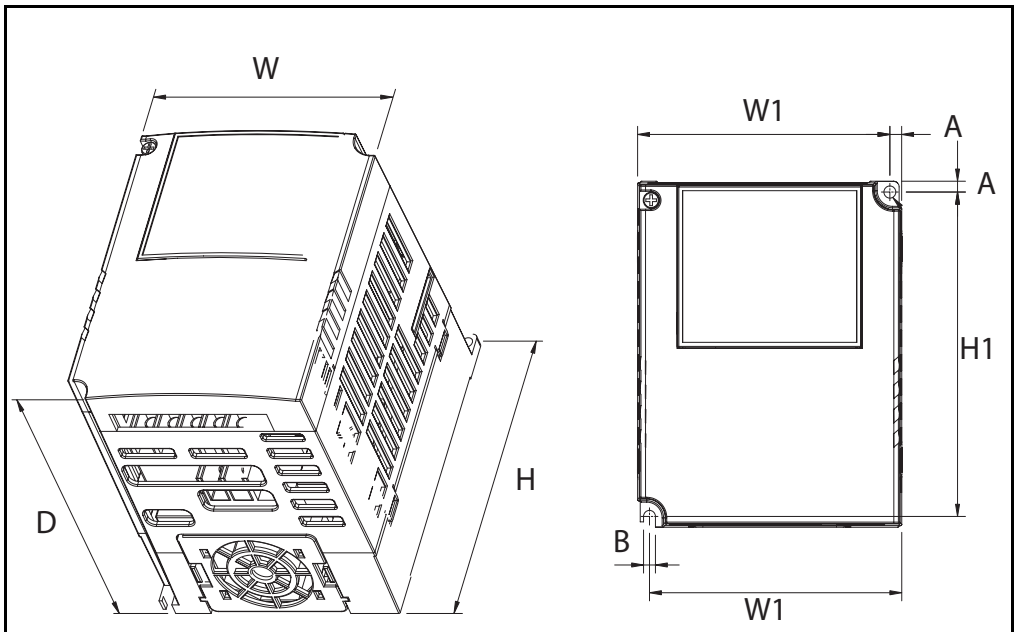
3.1.3 Mounting Dimensions for the VS1MD Drive

Overall dimensions and weights are illustrated in figures 3.2, 3.3, 3.4 and 3.5 as an aid to calculating the total area required by the VS1-MD drive. Dimensions are in millimeters. Weights are in kilograms. See table 2.1 for drive ratings by frame.



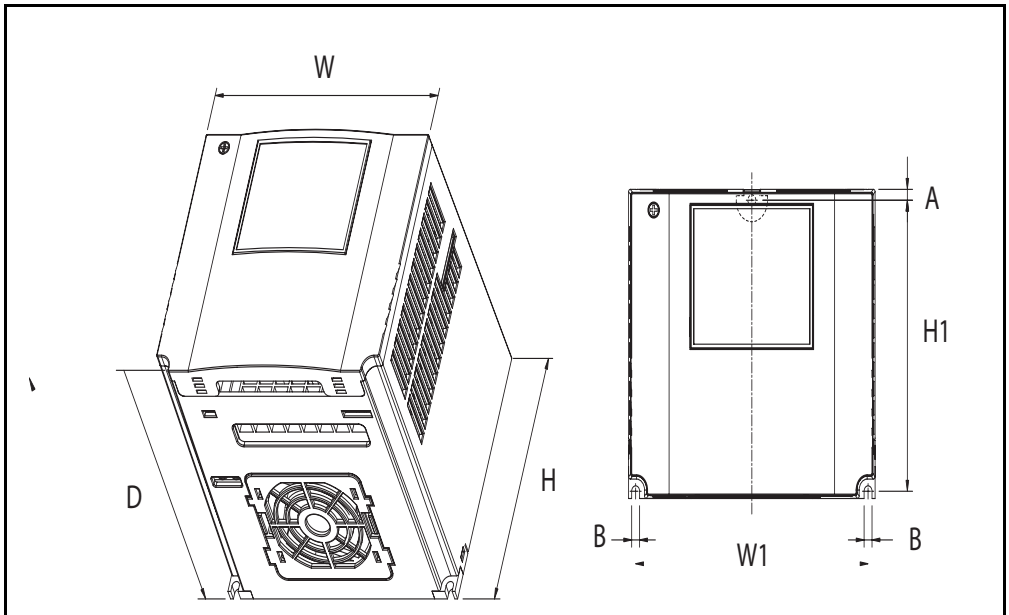
Frame Size A	HP	W	W1	H	H1	D	A	B	kg
230V/460V	0.5	70	65.5	128	119	130	4.5	4.0	0.76
230V/460V	1.0	70	65.5	128	119	130	4.5	4.0	0.77

Figure 3.2 – Drive Dimensions and Weights Frame A



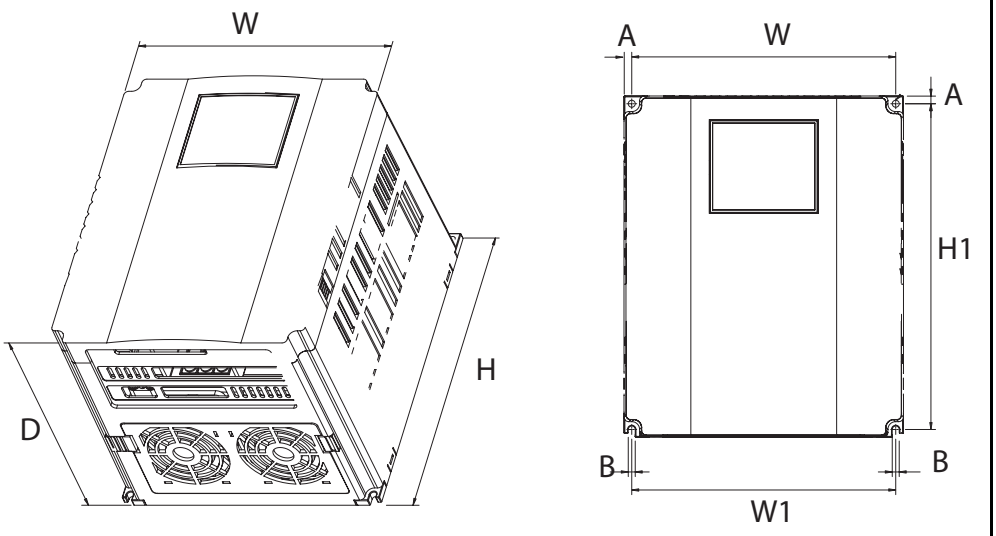
Frame Size B	HP	W	W1	H	H1	D	A	B	kg
230V/460V	2.0	100	95.5	128	120	130	4.5	4.5	1.12

Figure 3.3 – Drive Dimensions and Weights Frame B



Frame Size C	HP	W	W1	H	H1	D	A	B	kg
230V/460V	3.0	140	132	128	120.5	155	4.5	4.5	1.84
230V/460V	5.0	140	132	128	120.5	155	4.5	4.5	1.89

Figure 3.4 – Drive Dimensions and Weights Frame C



Frame Size D	HP	W	W1	H	H1	D	A	B	kg
230V/460V	7.5	180	170	220	210	170	5.0	4.5	3.66
230V/460V	10.0	180	170	220	210	170	5.0	4.5	3.66

Figure 3.5 – Drive Dimensions and Weights Frame D

3.2 Mounting the Drive

Mount the drive upright on a flat, vertical, and level surface.

Table 3.1 – Mounting Specifications

Frame	Screw Size	Screw Torque
A	M3.5 (#6-32)	0.67 - 0.97 N-m (6 - 8 in-lb)
B	M4 (#8-32)	1.56 - 1.96 N-m (14 -17 in-lb)
C	M4 (#8-32)	1.56 - 1.96 N-m (14 -17 in-lb)
D	M4 (#8-32)	1.56 - 1.96 N-m (14 -17 in-lb)

3.2.1 Protecting the Drive from Debris

The drive must be protected from debris falling through the vents in the top of the drive during installation and operation. The drive is designed to operate in IP20/Open Type application mounted in a protective enclosure. A conduit kit is available as an option which provides a top panel to block the top vents and prevent debris from entering the drive.

3.3 Watts Loss Data

Table 3.2 – Watts Loss Data

Model #	HP	Frame	Watts Loss
230 Volts			
VS1MD20P5	0.5	A	13
VS1MD21	1.0	A	28
VS1MD22	2.0	B	18
VS1MD23	3.0	C	56
VS1MD25	5.0	C	98
VS1MD27	7.5	D	73
VS1MD210	10.0	D	70
460 Volts			
VS1MD40P5	0.5	A	9
VS1MD41	1.0	A	22
VS1MD42	2.0	B	32
VS1MD43	3.0	C	47
VS1MD45	5.0	C	94
VS1MD47	7.5	D	84
VS1MD410	10.0	D	113

CHAPTER 4
Power Wiring

4.1 Grounding the Drive

ATTENTION: The following information is merely a guide for proper installation. Baldor Electric Company cannot assume responsibility for the compliance or the noncompliance to any code, national, local or otherwise for the proper installation of this drive or associated equipment. A hazard of personal injury and/or equipment damage exists if codes are ignored during installation.

ATTENTION: Use the dedicated ground terminal to ground the drive. Do not use the screw in the case or chassis, etc for grounding.

The drive Safety Ground - ⏚ must be connected to system ground. Ground impedance must conform to the requirements of national and local industrial safety regulations and/or electrical codes. The integrity of all ground connections should be periodically checked.

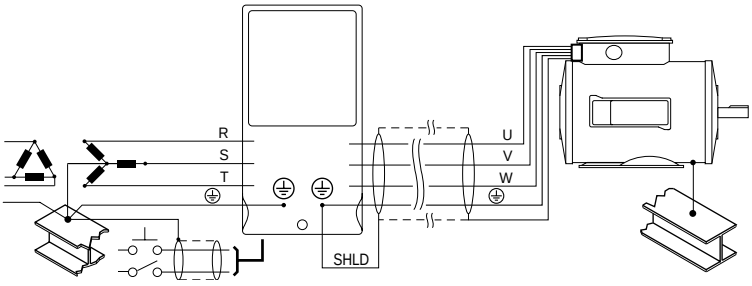


Figure 4.1 – Typical Grounding

Ground Fault Monitoring

If a system ground fault monitor is to be used, only Type B devices should be used to avoid nuisance tripping.

Safety Ground - ⏚

This is the safety ground for the drive that is required by code. One of these points must be connected to adjacent building steel (girder, joist), a floor ground rod, or bus bar. Grounding points must comply with national and local industrial safety regulations and/or electrical codes.

Motor Ground

The motor ground must be connected to one of the ground terminals on the drive.

Shield Termination - SHLD

Either of the safety ground terminals provides a grounding point for the motor cable shield. The **motor cable** shield connected to one of these terminals (drive end) should also be connected to the motor frame (motor end). Use a shield terminating or EMI clamp to connect the shield to the safety ground terminal.

When shielded cable is used for **control and signal wiring**, the shield should be grounded at the source end only, not at the drive end.

4.1.1 RFI Filter Grounding

Using drives with RFI filters may result in relatively high ground leakage currents. Therefore, the **filter must only be used in installations with grounded AC supply systems and be permanently installed and solidly grounded** (bonded) to the building power distribution ground.

Ensure that the incoming supply neutral is solidly connected (bonded) to the same building power distribution ground. Grounding must not rely on flexible cables and should not include any form of plug or socket that would permit inadvertent disconnection. Some local codes may require redundant ground connections. The integrity of all connections should be periodically checked.

4.1.2 Grounding Procedure

Step 1. Remove the front cover.

Step 2. Connect the Grounding wire to the ground terminal through the opening for ground terminal. Enter the screw driver from vertical to the terminal and secure the screw tightly.

4.1.3 Grounding Guidelines

Table 4.1 – Grounding Guidelines

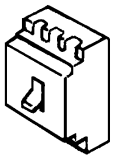
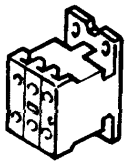
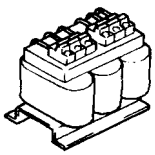
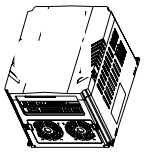
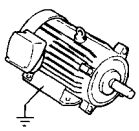
Inverter capacity	200V Class			400V Class		
	Wire size	Terminal screw	Grounding method	Wire size	Terminal screw	Grounding method
0.5 HP	3.5 mm^2	M3	Type 3	2 mm^2	M3	Special Type 3
1.0 HP	3.5 mm^2	M3		2 mm^2	M3	
2.0 HP	3.5 mm^2	M3		2 mm^2	M3	
3.0 HP	3.5 mm^2	M3		2 mm^2	M3	
7.5 HP	5.5 mm^2	M4		3.5 mm^2	M4	

4.2 Connecting Peripheral Devices to the VS1MD Drive

ATTENTION: Appropriate peripheral devices must be selected and correct connections made to ensure proper operation. You must read and understand this manual thoroughly before proceeding. Failure to observe this precaution could result in damage to, or destruction of, the equipment.

The following devices are required to operate the VS1MD drive.

Table 4.2 – Peripheral Devices for the VS1MD Drive

	AC Source Supply	Use a power supply within the permissible range for the drive's input power rating.
	MCCB or Earth leakage circuit breaker (ELB)	Select circuit breakers with care. A large inrush current may flow in the converter when power is turned on.
	Magnetic Contactor	Install a magnetic contactor if necessary. When installed, do not use the contactor for the purpose of starting or stopping.
	Reactors	Reactors must be used when the power factor needs to be improved or the drive is installed within 10 m of a large power supply system (1000kVA or more).
	Installation and wiring	To ensure optimal operation and life span of the drive, install it in an approriate place with proper orientation and clearances. Incorrect terminal wiring can result in damage to the equipment.
	To motor	Do not connect a power factor capacitor, surge suppresor, or radio noise filter to the output side of the drive.

4.3 Power Terminal Wiring

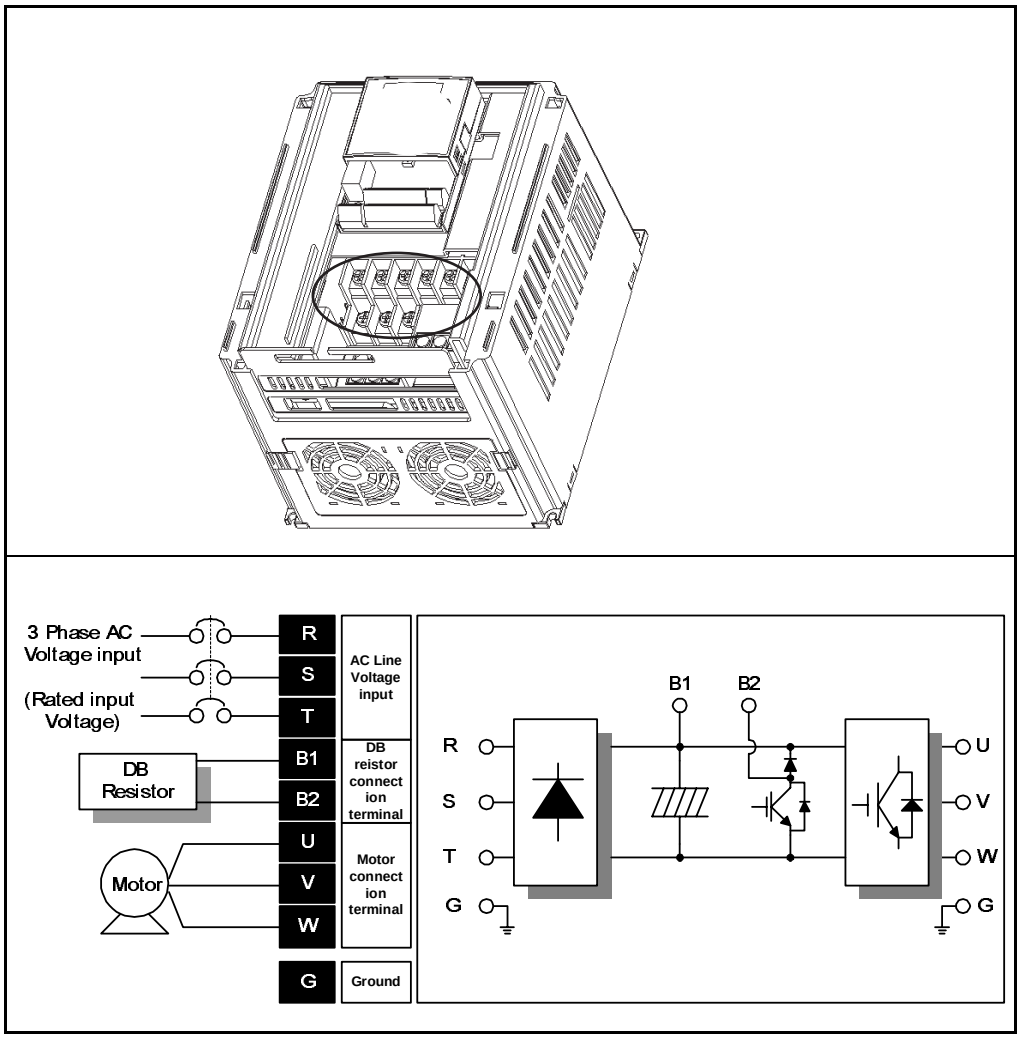
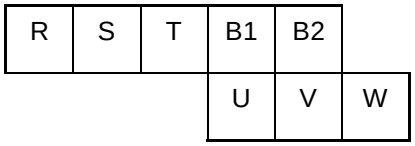


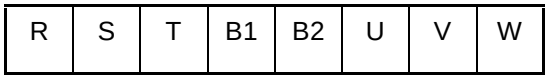
Figure 4.2 – Power Terminal Wiring

4.4 Specifications for Power Terminal Block Wiring

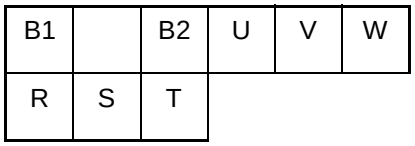
VS1MD20P5, VS1MD21, VS1MD40P5, VS1MD41, VS1MD22, VS1MD42



VS1MD23, VS1MD43, VS1MD25, VS1MD45



VS1MD27, VS1MD210, VS1MD47, VS1MD410



Model Number	R,S,T wire size		U, V, W wire size		Ground Wire		Screw size	Terminal torque
	mm^2	AWG	mm^2	AWG	mm^2	AWG	Terminal Screw Size	Screw Torque (Kgf.cm/lb-in)
VS1MD20P5	2	14	2	14	3.5	12	M3.5	10/8.7
VS1MD21	2	14	2	14	3.5	12	M3.5	10/8.7
VS1MD22	2	14	2	14	3.5	12	M3.5	10/8.7
VS1MD23	2	14	2	14	3.5	12	M4	15/13
VS1MD25	3.5	12	3.5	12	3.5	12	M4	15/13
VS1MD27	5.5	10	5.5	10	5.5	10	M5	32/28
VS1MD10	8	8	8	8	5.5	10	M5	32/28
VS1MD40P5	2	14	2	14	2	14	M3.5	10/8.7
VS1MD41	2	14	2	14	2	14	M3.5	10/8.7
VS1MD42	2	14	2	14	2	14	M4	15/13
VS1MD43	2	14	2	14	2	14	M4	15/13
VS1MD45	2	14	2	14	2	14	M4	15/13
VS1MD47	3.5	12	2	14	3.5	12	M5	32/28
VS1MD410	3.5	12	3.5	12	3.5	12	M5	32/28

* Strip the sheaths of the wire insulation 7mm when a ring terminal is not used for power connection.

4.5 Recommended Breakers

Table 4.3 – Circuit Breaker Ratings by Model Number

Model	Breaker		Model	Breaker	
	Current[A]	Voltage[V]		Current[A]	Voltage[V]
VS1MD20P5	30	230	VS1MD40P5	30	460
VS1MD21	30	230	VS1MD41	30	460
VS1MD22	30	230	VS1MD42	30	460
VS1MD23	30	230	VS1MD43	30	460
VS1MD25	30	230	VS1MD45	30	460
VS1MD27	50	230	VS1MD47	30	460
VS1MD10	60	230	VS1MD410	30	460

4.6 Recommended Fuses and AC Reactors

Model	External fuse		AC reactor
	Current[A]	Voltage[V]	
VS1MD20P5	10 A	500	4.20mH, 3.5A
VS1MD21	10 A	500	2.13mH, 5.7A
VS1MD22	15 A	500	1.20mH, 10A
VS1MD23	25 A	500	0.88mH,14A
VS1MD25	40 A	500	0.56mH, 20A
VS1MD27	40 A	500	0.39mH, 30A
VS1MD210	50 A	500	0.28mH, 40A
VS1MD40P5	5 A	500	18.0mH, 1.3A
VS1MD41	10 A	500	8.63mH, 2.8A
VS1MD42	10 A	500	4.81mH, 4.8A
VS1MD43	10 A	500	3.23mH, 7.5A
VS1MD45	20 A	500	2.34mH, 10A
VS1MD47	20 A	500	1.22mH, 15A
VS1MD4100	30 A	500	1.14mH, 20A

ATTENTION: Suitable For Use On A Circuit Capable Of Delivering Not More Then 65,000 RMS Symmetrical Amperes. 240V drives or 480V drives Volts Maximum

ATTENTION: Use Class H or K5 UL Listed Input Fuse and UL Listed Breaker Only. See the table above for the voltage and current rating of the fuse and the breaker.

4.7 Reflected Wave Protection

When more than one motor is connected to one inverter, total wiring length should be less than 200m (656ft). Do not use a 3-wire cable for long distances. Due to increased leakage capacitance between wires, over-current protective feature may operate or equipment connected to the output side may malfunction. In case of long wire length, lower carrier frequency or contact Baldor for recommendations.

Table 4.4 – Wire Length Recommendations

Length Between Inverter and Motor	Allowable Carrier Frequency
Up to 50 meters	Less than 15 kHz
Up to 100 meters	Less than 5 kHz
More than 100 meters	Less than 2.5 kHZ

CHAPTER 5
Control Wiring

This chapter describes how to wire the signal and I/O terminal strip for stop, speed feedback, and remote control signals.

	ATTENTION: Apply the rated torque to terminal screws. Loose screws can cause short circuit and malfunction. Tightening the screws too much can damage the terminals and cause short circuit and malfunction. **ATTENTION:** Make sure the input power is off before wiring. **ATTENTION:** After power supply is switched off following operation, wait at least 10 minutes after LED keypad display is off before you start working on it. **ATTENTION:** Applying input power supply to the output terminals U, V and W causes internal inverter damage. **ATTENTION:** Use ring terminals with insulated caps when wiring the input power and motor wiring. **ATTENTION:** Do not leave wire fragments inside the inverter. Wire fragments can cause faults, breakdowns and malfunctions. **ATTENTION:** When more than one motor is connected to one inverter, total wiring length should be less than 200m (656ft). Do not use a 3-wire cable for long distances. Due to increased leakage capacitance between wires, over-current protective feature may operate or equipment connected to the output side may malfunction. In case of long wire length, lower carrier frequency or contact Baldor for recommendations. **ATTENTION:** Never short B1 and B2 terminals. Shorting terminals may cause internal inverter damage. **ATTENTION:** Do not install a power factor capacitor, surge suppressor or RFI filter in the output side of the inverter. Doing so may damage these components.

5.1 Stop Circuit Requirements

	ATTENTION: You must provide an external, hardwired emergency stop circuit outside of the drive circuitry. This circuit must disable the system in case of improper operation. Uncontrolled machine operation can result if this procedure is not followed. Failure to observe this precaution could result in bodily injury.

In addition to the operational stop, you must provide a hardwired emergency stop external to the drive. The emergency stop circuit must contain only hardwired electromechanical components. Operation of the emergency stop must not depend on electronic logic (hardware or software) or on the communication of commands over an electronic network or link. Note that the hardwired emergency stop you install can be used at any time to stop the drive.

5.2 Motor Start/Stop Precautions

ATTENTION: A contactor or other device that routinely disconnects and reapplies the AC line to the drive to start and stop the motor can cause drive hardware damage. The drive is designed to use control input signals that will start and stop the motor. If used, the input device must not exceed one operation per minute or drive damage can occur. Failure to observe this precaution can result in damage to, or destruction of, equipment.

ATTENTION: The drive start/stop control circuitry includes solid-state components. If hazards due to accidental contact with moving machinery or unintentional flow of liquid, gas or solids exist, an additional hardwired stop circuit may be required to remove the AC line to the drive. When the AC line is removed, there will be a loss of any inherent regenerative braking effect that might be present - the motor will coast to a stop. An auxiliary braking method may be required.

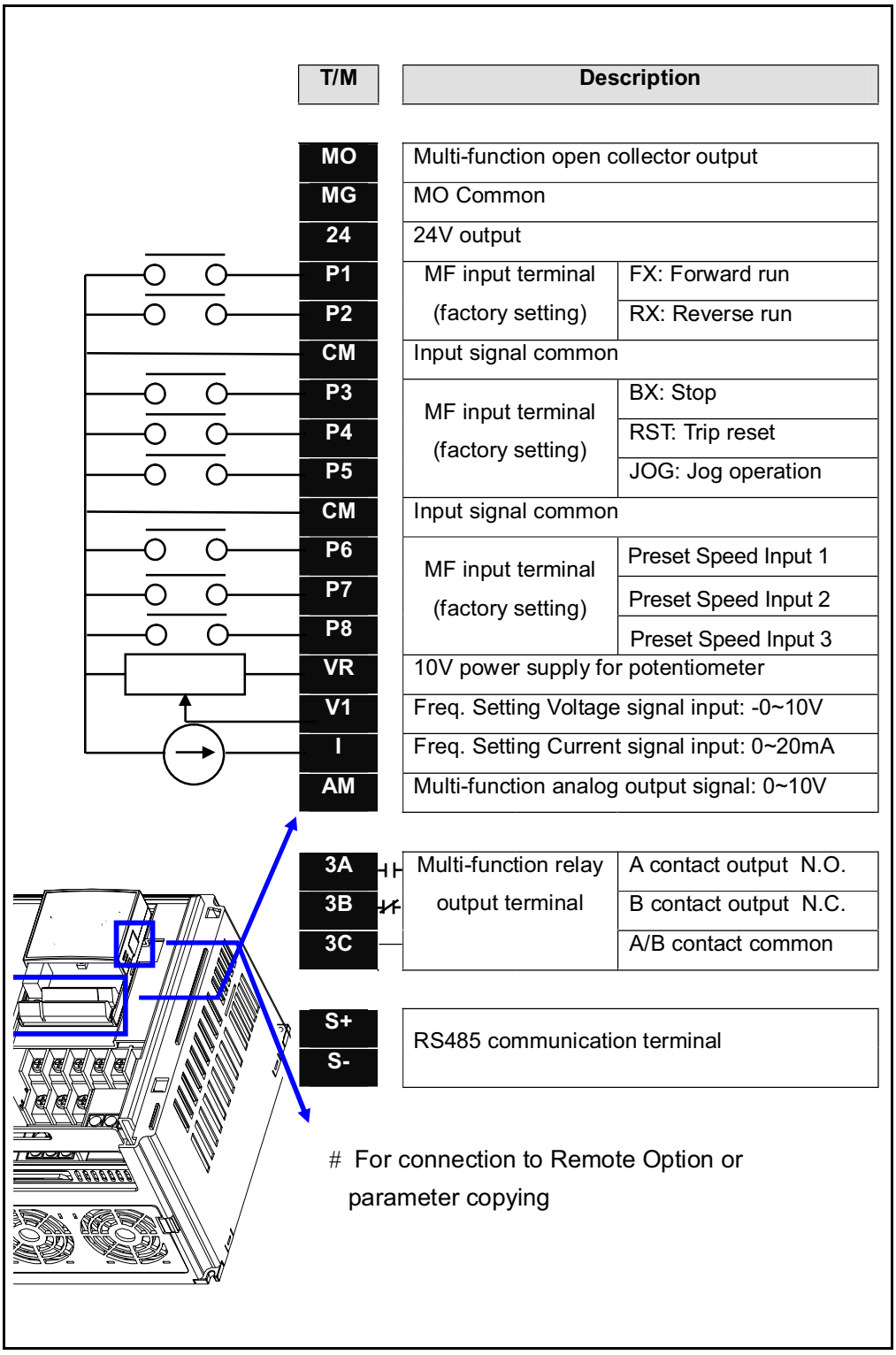
Important points to remember about I/O wiring:

- Always use copper wire.
- Wire with an insulation rating of 600V or greater is recommended.
- Control and signal wires should be separated from power wires by at least 0.3 meters (1 foot).

Important: I/O terminals labeled “Common” **are not** referenced to the safety ground terminal and are designed to greatly reduce common mode interference.

ATTENTION: Driving the 4-20 mA analog input from a voltage source could cause component damage. Verify proper configuration prior to applying input signals.

5.3 Terminal Wiring (Control I/O)

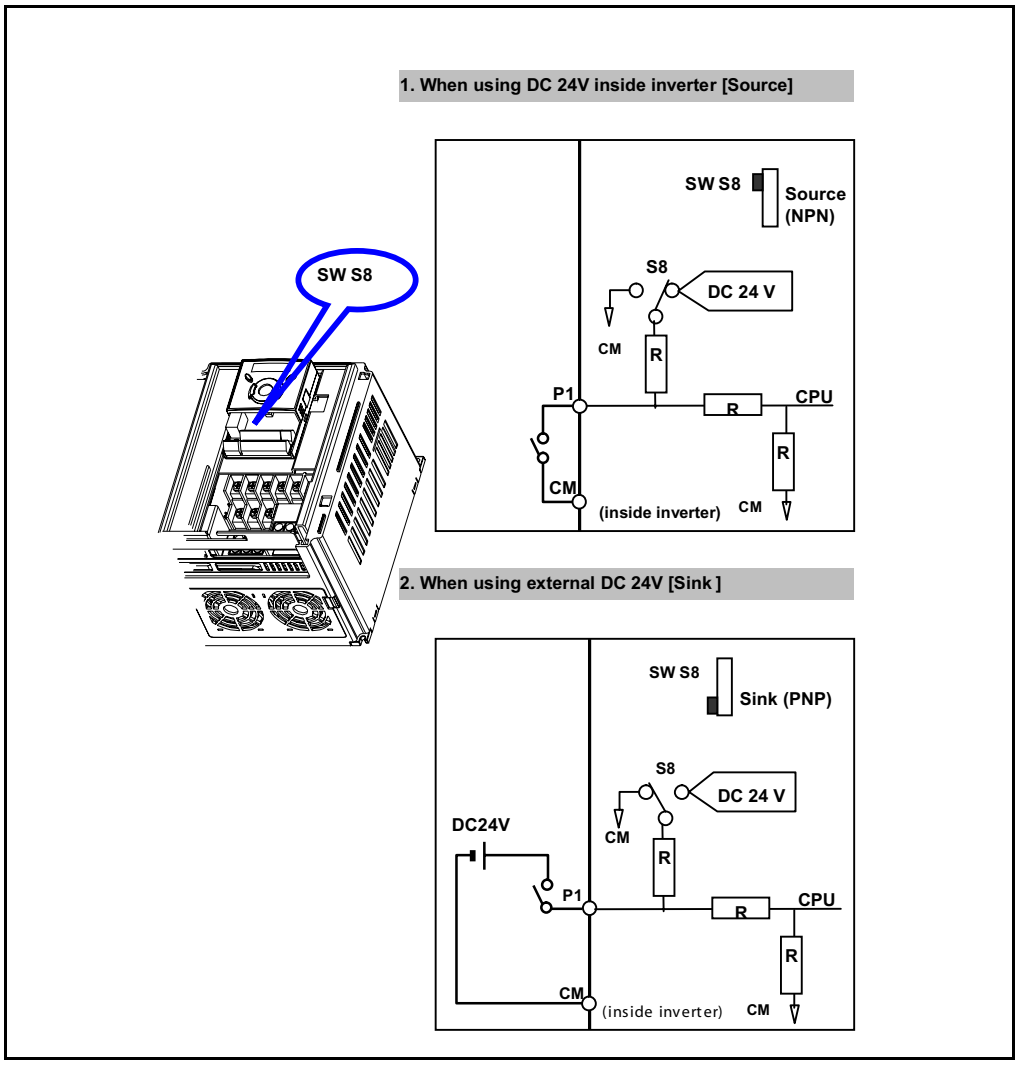


5.4 Control Terminal Specifications

			MO	MG	24	P1	P2	CM	P3	P4	S-	S+
3A	3B	3C		P5	CM	P6	P7	P8	VR	V1	I	AM

T/M	Terminal Description	Wire size[mm^2]		Screw size	Torque [Nm]	Specification
		solid wire	stranded			
P1 to P8	Multi-function digital input T/M 1-8	1.0	1.5	M2.6	0.4	
CM	Common Terminal	1.0	1.5	M2.6	0.4	
VR	Power supply for external speed potentiometer	1.0	1.5	M2.6	0.4	Output Voltage: 12 V Max output current: 10mA Potentiometer: 1 - 5 kohm
V1	Input terminal for Voltage operation	1.0	1.5	M2.6	0.4	Max input voltage: -12V - +12V input
I	Input terminal for Current operation	1.0	1.5	M2.6	0.4	0 - 20 mA input Internal Resister: 250 ohm
AM	Multi-function analog output terminal	1.0	1.5	M2.6	0.4	Max output voltage: 11 V Max output current: 100mA
MO	Multi-function terminal for open collector output	1.0	1.5	M2.6	0.4	Below DC 26V, 100mA
MG	Ground terminal for external power supply	1.0	1.5	M2.6	0.4	
24	24V External Power Supply	1.0	1.5	M2.6	0.4	Max output current: 100mA
3A	Multi-function relay output A contact N.O.	1.0	1.5	M2.6	0.4	Below AC 250V, 1A
3B	Multi-function relay output B contact N.C.	1.0	1.5	M2.6	0.4	Below DC 30V, 1A
3C	Common for Multi-function relays	1.0	1.5	M2.6	0.4	

5.5 Source/Sync for Input Control Wiring



5.6 I/O Wiring Recommendations

Table 5.1 – Recommended Control and Signal Wire[1]

Wire Type(s)	Description	Minimum Insulation Rating
Belden 8760/9460 (or equiv.)	0.8 mm^2 (18AWG), twisted pair, 100% shield with drain.	300 V 75° C (167° F)
Belden 8770 (or equiv.)	0.8 mm^2 (18AWG), 3 conductor, shielded for remote pot only.	

[1]If the wires are short and contained within a cabinet that has no sensitive circuits, the use of shielded wire may not be necessary, but is always recommended.

Table 5.2 – I/O Terminal Block Specifications

Maximum Wire Size[1]	Minimum Wire Size[1]	Torque
1.3 mm^2 (16 AWG)	0.13 mm^2 (26 AWG)	0.5 to 0.8 Nm (4.4 in-lb to 7 in-lb)

[1]Maximum / minimum that the terminal block will accept. These are not recommendations.

5.6.1 Maximum Control Wire Length Recommendations

Do not exceed control wiring length of 30 meters (100 feet). Control signal cable length is highly dependent on electrical environment and installation practices. To improve noise immunity, the I/O terminal block Common must be connected to ground terminal/protective earth.

5.7 Technical Specifications

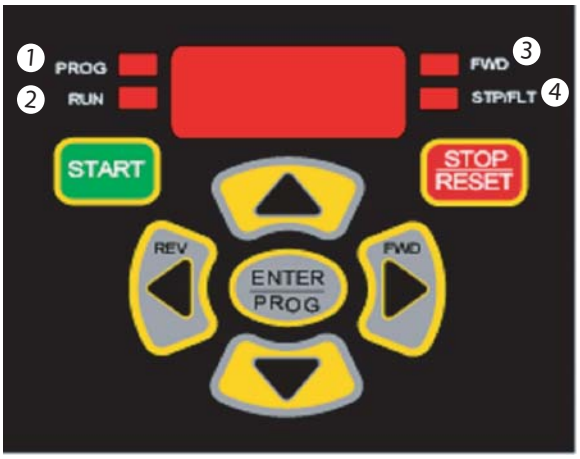
Please see Appendix A - Technical Specifications for detailed electrical information.

CHAPTER 6
Using the Keypad

Factory-default parameter values allow the drive to be controlled from the integral keypad. No programming is required to start, stop, change direction, or control speed directly from the integral keypad.

This chapter provides an overview of the integrated keypad and how to use it to program the VS1MD drive.

6.1 Keypad Components



Refer to table 6.1 for the LED descriptions noted by ❶ through ❹ and table 6.2 for key definitions.

6.1.1 Display Description

The alpha-numeric display indicates the following:

- Operational Values (such as Output Frequency)
- Parameter Numbers
- Parameter Values
- Fault Codes

6.2 LED Descriptions

Refer to figure 6.1 for the location of the LEDs described in table 6.1.

Table 6.1 – LED Descriptions

No.	LED	LED State	Description
❶	PROG	Steady Red (On)	Indicates the drive is in programming mode.
		(Off)	Indicates the drive is in operational Mode.
❷	RUN	Steady Red (On)	Indicates the drive is running at commanded speed.
		Flashing Red	Indicates drive is accelerating or decelerating to new speed setting.
		(Off)	Drive is not running.
❸	FWD	Steady Red (On)	Indicates the drive is in forward operation.
		(Off)	Indicates the drive is in reverse operation.
❹	STP/FLT	Steady Red (On)	Indicates the drive is in a stopped position.
		Flashing Red	Indicates the drive is faulted.
		(Off)	Drive is running.

6.3 Key Descriptions

Refer to figure 6.1 for the location of the keys described in table 6.2.

Table 6.2 – Key Descriptions

Key	Name	Description
	Run Key	• Starts the drive. • Active when the input mode is programmed for keypad control.
	Stop Key	• Stops the drive in programmed stop mode. • Always active. • Reset active faults.
	Ent/Prog Key	• Accesses programming menu and locks in changed values. • To enter programming mode, the Ent/Prog key must be held in for 2 seconds. • Holding the Ent/Prog key for 2 seconds or more will escape back to Control Reference Mode or back out of a parameter edit function.

Table 6.2 – Key Descriptions (Continued)

Key	Name	Description
	Speed Reference Keys	Operation Mode: • Changes the commanded speed reference. • Only active when the input mode is programmed for keypad control. • The Up-Arrow increases the speed reference at a controlled rate. • The Down-Arrow decreases the speed reference at a controlled rate. • Holding either arrow for a set period of time will increase the reference ramp rate. Program Mode: • Increment / Decrement parameter numbers or parameter values
	Direction Keys	Operation Mode: • Only active when the input mode is programmed for keypad control. • Direction keys are active only when operating in reference command mode. • Reverse may also be disabled by a parameter. Program Mode: • Cycle through the parameter groups or shift to the next digit to be changed while in the parameter edit mode.

6.4 About Parameters

To program the drive for a specific application, you adjust the appropriate parameters. The parameters are used to define characteristics of the drive.

There are three types of parameters:

- **Numbered List Parameters (Enumerated Parameters)**
  Numbered list parameters allow a selection from two or more options. Each item is represented by a number.
  Example: Start/Stop Source (P38)
- **Bit Parameters**
  Bit parameters have individual bits associated with features or conditions. If the bit is 0, the feature is off or the condition is false. If the bit is 1, the feature is on or the condition is true.
  Example: Terminal Status Display (d7)
- **Numeric Parameters**
  These parameters have a single numerical value (for example, 0.1 volts).
  Example: Motor Rated Current (P32)

Parameters are also either configurable or tunable, or read-only.

Configurable parameters can be adjusted or changed only while the drive is stopped.

Tunable parameters can be adjusted or changed while the drive is running or stopped.

Read-only parameters cannot be adjusted.

6.5 How Parameters are Organized

Parameters are organized into five Parameter Groups:

- The Display Parameter Group (dnn) contains parameters for the display of basic drive information.
- The Programming Parameter Group (Pnn) contains the most commonly used parameters for startup and operation.
- The Terminal Parameter Group (tnn) contains a linear list of input and output control parameters.
- Function Group 1 Parameters (Fnn) contains a linear list of advanced motor control parameters.
- Function Group 2 Parameters (Hnn) contains a linear list of advanced motor profile parameters.

6.6 Moving Between Parameter Groups

Use the following procedure to enter the programming mode and to move between groups:

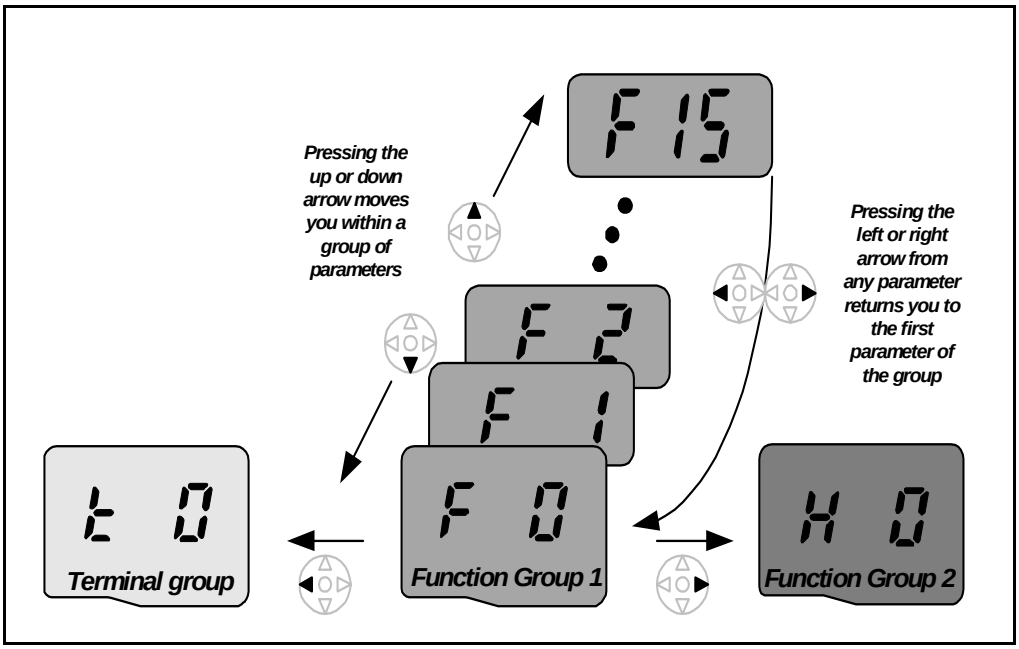
Table 6.3 – Moving Between Parameter Groups

Procedure	Sample Display
Step 1. When the drive first powers up, the display will indicate the value of the “Power ON Display,” which is defined in Parameter H72. The default “Power On Display” is the commanded frequency.	
Step 2. Press and hold down the ENTER key for at least two seconds to change the drive from the operation mode to the programming mode.The “PROG” LED will illuminate indicating that the drive is in programming mode. The drive will display the first parameter of the “Display” group.	
Step 3. Press the right arrow key to change to the “Parameters Group”.	
Step 4. Press the right arrow key to change to the “Terminal Group”.	

Table 6.3 – Moving Between Parameter Groups

Procedure	Sample Display
Step 5. Press the right arrow key to change to “Function Group 1”.	
Step 6. Press the right arrow key to change to “Function Group 2”.	
Step 7. Press the right arrow key to change to “Display” group.	
Step 8. Press and hold down the ENTER key for at least two seconds to change the drive from the programming mode back to operation mode.The “PROG” LED will go out indicating that the drive is in operation mode. The drive will display the default “Power On Display”.	
Note that the above can be execute in reverse order by using the left arrow key instead of the right arrow key.	

You can only move between groups while the first parameter of the group is displayed. Pressing the left or right arrow while displaying any parameter other than the first parameter of the group returns to the first parameter of the group.


Pressing the up or down arrow moves you within a group of parameters
Pressing the left or right arrow from any parameter returns you to the first parameter of the group
F15
F2
F1
F0
t0
H0
Terminal group
Function Group 1
Function Group 2

The below example indicates the steps needed to move from parameter F35 to Function Group 2.

Table 6.4 – Moving from F35 to Function Group 2

Procedure	Sample Display
Step 1. When a parameter other than the first in a group is displayed, you must initially go to the first parameter of the group prior to going to the next group. For this example, parameter F35 of Function Group 1 is currently displayed and you want to go to Function Group 2 (H Parameters).	
Step 2. Press the left or right arrow and parameter F0 will be displayed.	
Step 3. Press the right arrow key to change to “Function Group 2”.	

6.7 Changing Between Parameters Within a Group

Each group contains parameters arranged in a linear list. The list can be navigated using the Up and Down arrows.

Table 6.5 – Changing Between Parameters Withing a Group

Procedure	Sample Display
Step 1. From the operation mode, press and hold down the ENTER key for at least two seconds to change the drive to the programming mode. The “PROG” LED will illuminate indicating that the drive is in programming mode. The drive will display the first parameter of the “Display” group.	
Step 2. Press the up arrow to display the next parameter.	
Step 3. Press the up arrow again to display the next parameter, continue until the desired parameter is displayed.	
Note that using the down arrow allows navigation through the parameters in reverse order.	

The first parameter of each group, with the exception of the “Display Group”, is a special parameter called a “Jump Code”. The parameter can be used to jump to a specific parameter within a group without having to scroll through the parameters using the up and down arrows. Once the Jump Code is programmed, the drive will save the setting for future use, but this can always be reprogrammed to jump to a different parameter.

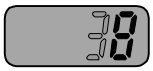
The following example illustrates the use of a Jump Code to jump to parameter P38.

Table 6.6 – Using the Jump Code

Procedure	Sample Display
Step 1. From the operation mode, press and hold down the ENTER key for at least two seconds to change the drive to the programming mode. The “PROG” LED will illuminate indicating that the drive is in programming mode. The drive will display the first parameter of the “Display” group.	
Step 2. Press the right arrow to change to the “Parameters” group.	
Step 3. Press the ENTER key to edit P0 (Jump Code).	
Step 4. Press the UP arrow seven times until the display indicates an “8”.	
Step 5. Press the left arrow one time such that the next digit is displayed. It will be displayed brighter than the previous digit.	
Step 6. Press the UP arrow three times such that the display indicates the parameter number.	
Step 7. Press the ENTER key to accept the value. The value will be saved in the Jump Code (P0) for future use and the desired parameter will immediately be displayed.	

The following example shows how to use a previously stored Jump Code.

Table 6.7 – Using a Previously Stored Jump Code

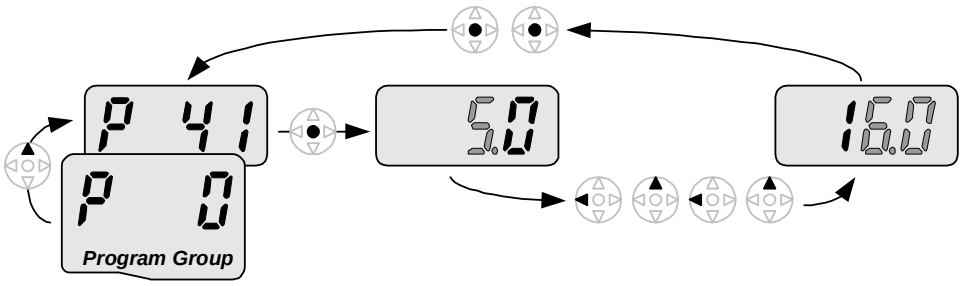
Procedure	Sample Display
Step 1. From the operation mode, press and hold down the ENTER key for at least two seconds to change the drive to the programming mode. The “PROG” LED will illuminate indicating that the drive is in programming mode. The drive will display the first parameter of the “Display” group.	
Step 2. Press the right arrow to change to the “Parameters” group.	
Step 3. Press the ENTER key to access the Jump Code.	
Step 4. Press the ENTER key a second time and the desired parameter will be displayed.	

6.8 Modifying the Value of a Parameter

The parameters located in the Display group are read-only and can not be modified. All other parameters (with a few exceptions) can be modified by the user. Some parameters are configurable - meaning that the drive must be stopped before the parameter can be modified, while others are tunable - meaning that the parameter can be modified while the drive is stopped or running.

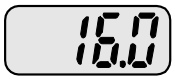
The following example shows how to modify the acceleration time located in parameter P41.

Table 6.8 – Modifying Parameter Values



Step 1. From the operation mode, press and hold down the ENTER key for at least two seconds to change the drive to the programming mode. The “PROG” LED will illuminate indicating that the drive is in programming mode. The drive will display the first parameter of the “Display” group.	d 0
Step 2. Press the right arrow key to change to the “Parameters” group.	P 0
Step 3. Use the up arrow or the jump code to display the acceleration time parameter P41.	P 41
Step 4. Momentarily press the ENTER key to begin the parameter value edit mode. Notice that the tenths digit is highlighted for editing. At this point you can use the up arrow key to increment the value all the way to the new setting (16.0 in this example) or proceed with the following steps.	5.0
Step 5. Press the left arrow key to select the ones digit for editing.	5.0
Step 6. Press the up arrow key to increment the ones digit from a 5 to a 6.	6.0
Step 7. Press the left arrow key to select the tens digit for editing.	06.0
Step 8. Press the up arrow key to increment the tens digit from a 0 to a 1.	16.0

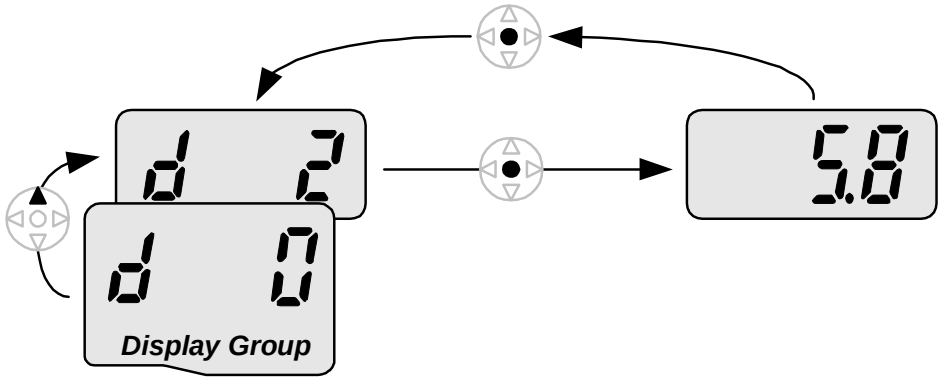
Table 6.8 – Modifying Parameter Values

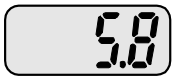
Step 9. Press the ENTER key to accept the value and the display will begin to flash so that you can confirm the entry.	
Step 10. Press the ENTER key a second time to acknowledge the entry. The display will revert to showing the parameter number.	

6.9 Monitoring Display Parameters

The Display group is a group that consists of read only values that can be monitored by the user to diagnose the operation of the drive and motor. To monitor the motor current, follow the below example.

Table 6.9 – Monitoring Display Parameters

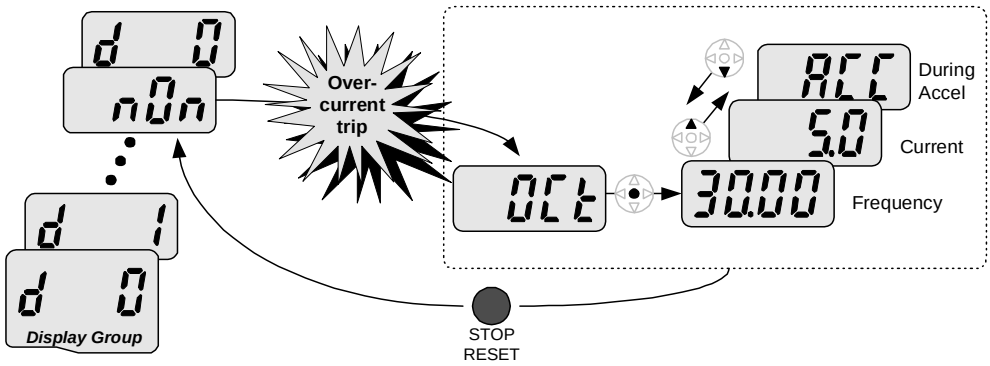


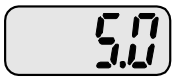
Step 1. From the operation mode, press and hold down the ENTER key for at least 2 seconds to change the drive to the programming mode. The “PROG” LED will illuminate indicating that you are in the programming mode. The drive will display the first parameter of the “Display” group.	
Step 2. Press the up arrow key twice to change to the parameter d2 (Motor Current).	
Step 3. Momentarily press the ENTER key to display the motor current. The display will be updated in real time.	
Step 4. Press the ENTER key to return to the previous display so that you can select a new parameter to view.	

6.10 Reviewing the Fault Status in the Display Group

When a fault is active, this is annunciated on the drive by flashing the STOP/FAULT LED. This procedure is used to review the active fault as well as certain conditions at the time the fault occurred.

Table 6.10 – Reviewing Fault Status in the Display Group

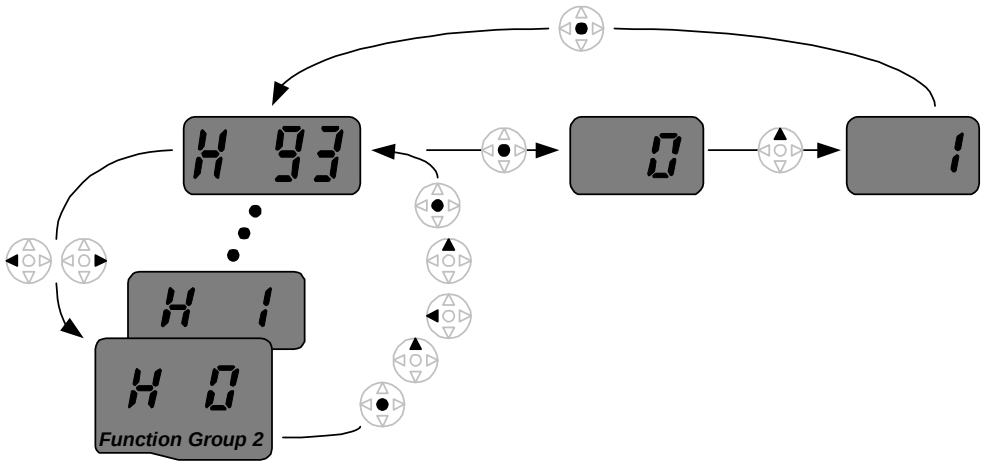


Step 1.	When an overcurrent condition has been detected by the drive, a fault will be latched and the display will show the condition.	
Step 2.	Press the ENTER key to see the frequency at which the fault occurred. This example indicates that the drive was outputting 30.00 Hz when the fault occurred.	
Step 3.	Press the up arrow to view the output current during the fault. This example indicates that the drive was outputting 5.0 Amps when the fault occurred.	
Step 4.	Press the up arrow key again to view the operating status of the drive when the fault occurred. This example indicates that the drive was accelerating when the fault occurred.	
Step 5.	Press the STOP/RESET button on the keypad to reset the fault and the STOP/FAULT LED will illuminate solid indicating that the fault is cleared and that the drive is in the stopped condition. The display will indicate that there is no longer a fault condition.	

6.11 Resetting the Parameters to Factory Default

Follow the below procedure to reset the parameters to the factory default values:

Table 6.11 – Resetting Parameters to Factory Default



Step 1. Navigate to the Function Group 2 (H Group).	
Step 2. Press the ENTER key to edit the jump code. Modify the jump code to be equal to 93.	
Step 3. Press the ENTER key to jump to parameter H93.	
Step 4. Press ENTER to display the current value of parameter H93 (it will be 0 indicating that parameters will not be reset).	
Step 5. Press the up arrow key to change the value to a 1.	
Step 6. Press the ENTER key to reset the drive parameters to factory default. The display will revert back to displaying the parameter number.	

CHAPTER 7
Parameter Descriptions

7.1 Overview

The following information is provided for each parameter listed in table 7.1 along with its description:

Parameter Number:	Unique number assigned to each parameter.
Parameter Name:	Unique name assigned to each parameter.
LED Display:	Display shown on LED screen when parameter is accessed.
Range:	Predefined parameter limits or selections. Note that a negative Hz value indicates reverse rotation.
Default:	Factory default setting.
Access:	• Read Only: Parameter value can not be modified by user. • Configurable: Parameter can only be modified while drive is stopped. • Tunable: Parameter can be modified while drive is running or stopped.
Group:	Menu group within which parameter is located.
See also:	Associated parameters that may provide additional or related information.

The parameters are presented in numerical order within each of the fivegroups (Dispay, Basic Parameters, Terminal, Function Group 1, Function Group 2). Appendix B contains a list of parameters by name cross-referenced to parameter number.

7.2 Display Group Parameters

Parameters in this group are display only and can be used to monitor drive conditions. To change the active display for the drive, use parameter H72 - Power On Display.

d0	**Frequency Command**	
	Range:	0.0 to Frequency High Limit (P36) [Hz]
	Default:	Read Only
	Displays the value of the active frequency command. The commanded frequency is displayed even if the drive is not running.	

d1	**Motor RPM**	
	Range:	0.0 Motor RPM (based on P33 Motor Poles) [RPM]
	Default:	Read Only
	Displays the output motor RPM. Motor RPM is scaled based on output frequency present on terminals U, V and W based on the setting in P33 – Motor Poles.	

d2	**Output Current**	
	Range:	0.0 to Motor Rated Current (P32) [Amps]
	Default:	Read Only
	Displays the value of the output current present at terminals U, V and W.	

d3	**Output Voltage**	
	Range:	0.0 to Drive Rated Voltage [volts]
	Default:	Read Only
	Displays output voltage present at U, V, W.	

d4	**Output Power**	
	Range:	0.0 to (Drive Rated Power x 2) [kW]
	Default:	Read Only
	Displays the value of the output power present at terminals U, V and W.	

d5 **Output Torque**

Range:	0.0 to (Drive Rated Torque x 2) [kgf / M]
Default:	Read Only
See Also:	H36

Displays the value of the output torque present at terminals U, V and W. Enter motor efficiency indicated on motor nameplate to H36 to display correct torque.

d6 **DC Link Voltage**

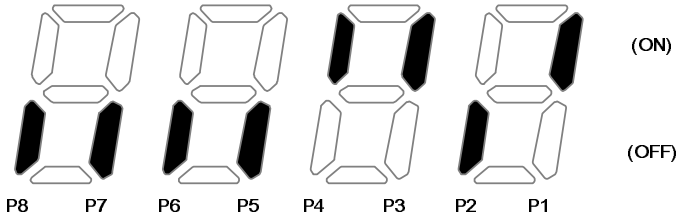
Range:	Based on Drive Rating [Volts DC]
Default:	Read Only

Displays the present DC bus voltage level.

d7 **Input Terminal status display**

Range:	See Figure Below
Default:	Read Only

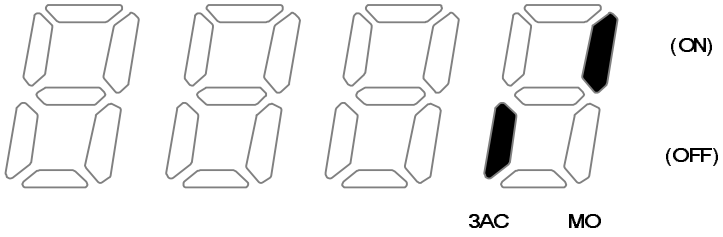
Displays the status of the input terminals P1~P8. An example is shown below for when P1, P3, P4 are ON and P2, P5 are OFF.



d8 **Output terminal status display**

Range:	See Figure Below
Default:	Read Only

Displays the status of the Digital (MO) Output and the Relay (3A~C) terminals. The following example is for when Digital Output (MO) is ON and the Relay is OFF.

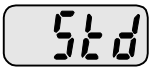


d9	**Software Version**	
	Range:	1.0 to 99.9
	Default:	Read Only

Displays the Main Control Board software version.

nOn	**Current Fault Display**	
	Range:	See Chapter 9 - Troubleshooting for fault code description
	Default:	Read Only
	See Also:	H1-H6

Displays the types of faults, frequency and operating status at the time of the last fault.

Fault Types	Frequency	
	Current	
	Accel/ Decel Information	Fault during Accel
		Fault during Decel
		 Fault during constant run

Fault code history can be viewed in parameters H1 - H5. H6 is used to clear the fault code history. For a complete description of fault codes, refer to Chapter 9 - Troubleshooting.

7.3 Basic Program Group Parameters

The Basic Program Group (P) contains the parameters most commonly used in start-up.

P0	Jump Code
Range:	30 -47
Default:	30
Access	Tunable

Sets the code to jump directly to a specific parameter within the group.

P30	Motor HP Select
Range:	0.5 = 0.5 HP 1 = 1 HP 2 = 2 HP 3 = 3 HP 5 = 5 HP 7.5 = 7.5 HP 10 = 10 HP
Default:	Preset based on drive rating.
Access	Configurable
See also:	P32 - P34

Sets the motor type connected to the drive output side.

P32	Motor Rated Current
Range:	0.5 - 50 Amps
Default:	Preset based on drive rating
Access	Configurable
See Also:	P30, P33, P34

Enter motor rated current on the nameplate.

P33	Pole Number
Range:	2, 4, 6, 8, 10, 12
Default:	4
Access	Configurable
See Also:	P30, P32, P34

Select number of motor poles

P34	Base Frequency	
	Range:	30 - 400 [Hz]
	Default:	60
	Access	Configurable
	See Also:	P30, P33, F30-F38

The drive outputs its rated voltage to the motor at this frequency (enter motor nameplate). See parameter F30 for custom V/Hz settings and V/Hz curve.

P35	Frequency Low Limit	
	Range:	0 - P36 [Hz]
	Default:	10.0
	Access	Configurable
	See Also:	P36, F30-F38

Sets drive minimum steady state output frequency.

P36	Frequency High Limit	
	Range:	0 - 400 [Hz]
	Default:	60.0
	Access	Configurable
	See Also:	P35

Sets drive maximum steady state output frequency.

P37	Frequency Command	
	Range:	0 - 400 [Hz]
	Default:	0.00
	Access	Tunable

This parameter manually sets the frequency that the drive is commanded to output.

Set the desired frequency and press ENTER/PROG to lock the value into memory. If the drive is running, it will immediately accelerate or decelerate to this value once enter is pressed. If the drive is not running, entering a value in P37 will pre-set the speed to accelerate to after a valid run command.

P38 **Stop/Start Source**

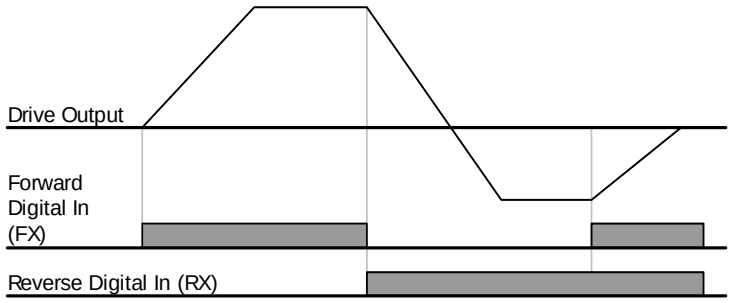
Range:	0 = Keypad 1 = Terminal Mode 1 (2 or 3- wire control for forward/reverse) 2 = Terminal Mode 2 (2 wire with direction switch) 3 = RS485 Communication
Default:	0 {Local OIM)
Access	Configurable
See Also:	P40; t1 - t8

Sets the control used to start the drive.

0	Keypad	Drive control for start, stop, forward and reverse are from drive keypad.
1	Terminal Operation	Drive is controlled from run forward terminal and run reverse terminal.
2		Drive is controlled from run terminal and directional terminal.
3	RS485 Communication	Drive operation controlled using RS-485 communications (see Appendix E).

Terminal Operation Mode 1: (2-Wire or 3-Wire Control Fwd/Rev):

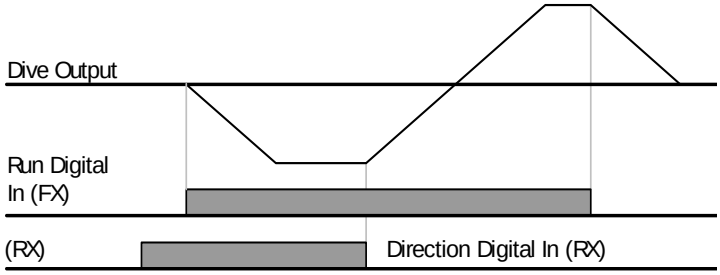
- Select one digital input (t1~t8) = 0, run forward (FX).
- Select one digital input (t1~t8) = 1, run reverse (RX).
- To enable 3-Wire control select one digital input (t1~t8) = 17, 3-wire operation.
- Drive stops when both inputs are off or when both inputs are on.



P38 Stop/Start Source

Terminal Operation Mode 2: (2-Wire Control with Fwd/Rev Switch):

- Select one digital input (t1~t8) = 0, run forward (FX). Operates as a Run Command
- Select one digital input (t1~t8) = 1, run reverse (RX). Operates as a Direction Switch
- To enable 3-Wire control select one digital input (t1~t8) = 17, 3-wire operation.
- Drive stops when both inputs are off or when both inputs are on.

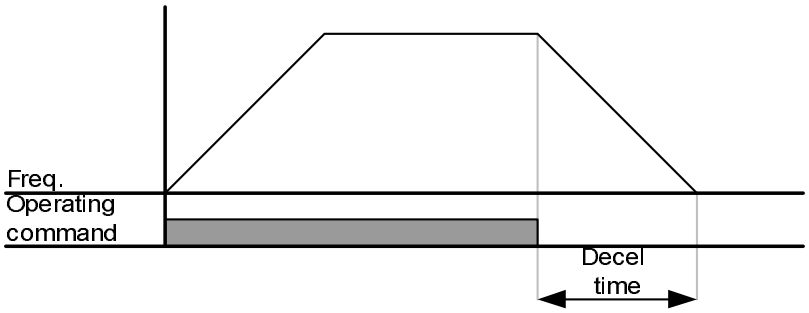


P39 Stop Type

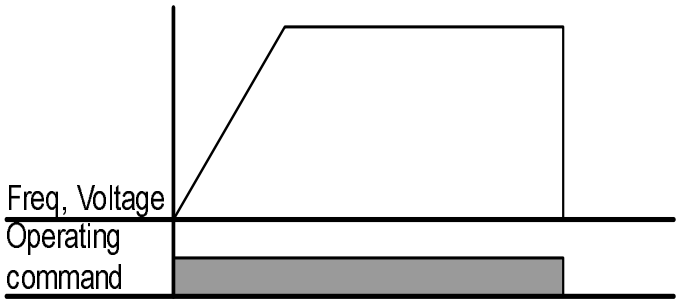
Range:	0 = Decelerate to Stop (Ramp) 1 = DC Brake to Stop 2 = Coast to Stop
Default:	0
Access	Configurable
See Also:	P38, P42, F8-F11

Sets the active mode for all stop sources.

0 = Decelerate to Stop. Motor decelerates to 0 Hz and stops during the set time.



1 = DC Brake to stop. See parameters F8 - F11 for further details.
2 = Coast to stop. Output frequency and voltage are shut down on a stop command



P40 Frequency Setting Method

Range:	1 = Digital Keypad 2 = Analog V1 1: -10 - +10V 3 = Analog V1 2: 0 ~ +10 V 4 = Analog Terminal I: 0 - 20mA 5 = Analog Terminal V1 Mode 1+ Terminal I 6 = Analog Terminal V1 Mode 1+ Terminal I 7 = Analog RS485
Default:	1
Access	Configurable
See Also:	t32-t33, F60

Sets the source of the speed reference to the drive.

1 = Keypad:Drive output frequency is set in the operation mode by pressing the up/down keys. The drive immediately responds to the new setting without pressing the enter key.

2 = Analog V1 Mode 1:Drive output frequency is set via a +/- 10V signal applied to analog input terminal V1.

3 = Analog V1 Mode 2:Drive output frequency is set via a 4~20mA signal applied to analog input terminal V1.

4 = Analog I:Drive output frequency is set via a 4~20mA signal applied to analog input terminal I.

5 = Analog V1 Mode 1 + I:Drive output frequency is set via the sum of a +/-10V signal applied to V1 and a 4~20mA signal applied to terminal I.

6 = Analog V1 Mode 2 + I:Drive output frequency is set via the sum of a 0~10V signal applied to V1 and a 4~20mA signal applied to terminal I.

7 = RS485:Drive output frequency is controlled via the RS485 communications port.

P41 Accel Time

P42 Decel Time

Range:	0 - 6,000 [sec]
Default:	P41 = 5.0, P42 = 10.0
Access	Tunable
See Also:	P42, P36, H70, H71

Sets the Accel/Decel time of the drive. When using the multiple accel/decel curves with preset speeds, this ramp serves as accel/decel time 0.

H71 can be used to scale the accel/decel units and H70 determines if the time to accel/decel is relative to P35 (Frequency High Limit) or the delta change of running frequency to set frequency.

P43 **Preset Speed 1**

P44 **Preset Speed 2**

P45 **Preset Speed 3**

Range:	0 - 400 [Hz]
Default:	P43 = 10, P44 = 20, P45 = 30
Access	Tunable
See Also:	t1-t8, t10-t13

Provides an internal fixed speed command selectable by digital inputs.

P46 **Drive Start/Stop Source 2**

Range:	0 - 3 (see table for P38)
Default:	1 = Terminal Mode 1
Access	Configurable
See Also:	P38, t1-t8
Note:	Only viewable when one of the t1-t8 terminals is set for 22 and P38 = 3 (RS485 Communications).

When RS485 communications is used as the primary mode of controlling the drive, this parameter serves as an alternate mode. It is selectable by a digital input (t1-t8) = “22”.

P47 **Frequency Setting Mode 2**

Range:	1-7 (see table for P40)
Default:	1 = Keypad
Access	Configurable
See Also:	P40, P47, t1-t8
Note:	Only viewable when one of the t1-t8 terminals is set for 22 and P40 = 7 (RS485 Communications).

When RS485 communications is used as the primary mode of controlling the drive, this parameter serves as an alternate mode. It is selectable by a digital input (t1-t8) = “22”.

7.4 Terminal Parameters

t0	**Jump Code**	
	Range:	0 - 81
	Default:	0
	Access	Tunable
	Sets the code to jump directly to a specfic parameter within the group.	

t1	**Digital Input 1 define (I/O Terminal P1)**	
t2	**Digital Input 2 define (I/O Terminal P2)**	
t3	**Digital Input 3 define (I/O Terminal P3)**	
t4	**Digital Input 4 define (I/O Terminal P4)**	
t5	**Digital Input 5 define (I/O Terminal P5)**	
t6	**Digital Input 6 define (I/O Terminal P6)**	
t7	**Digital Input 7 define (I/O Terminal P7)**	
t8	**Digital Input 8 define (I/O Terminal P8)**	
	Range:	0 =Forward Run Command 1 = Reverse Run Command 2 = Emergency Stop Trip 3 = Reset when a Fault occurs (RST) 4 = Jog Operation Command (2-wire only) 5 = Preset Speed Input - Bit 1 6 = Preset Speed Input - Bit 2 7 = Preset Speed Input - Bit 3 8 = Preset Speed Ramp - Bit 1 9 = Preset Speed Ramp - Bit 2 10 = Preset Speed Ramp - Bit 3 11 = DC Brake during start 12 = 2nd Motor Select 13 = Reserved 14 = Reserved 15 = Frequency increase (UP) Command 16 = Frequency decrease (DOWN) Command 17 = 3-wire operation 18 = External Trip: A Contact (EtA) 19 = External Trip: B Contact (EtB) 20 = Self-Diagnostic Function 21 = Exchange between PID operation and V/F operation 22 = Exchange between option (RS485) and Drive 23 = Analog Hold 24 = Accel/Decel Disable 25 = Up/Down Save Freq. Initialization
	Default:	t1=0, t2=1, t3=2, t4=3, t5=4, t6=5, t7=6, t8=7
	Access	Tunable
	Selects the function for the digital inputs.	

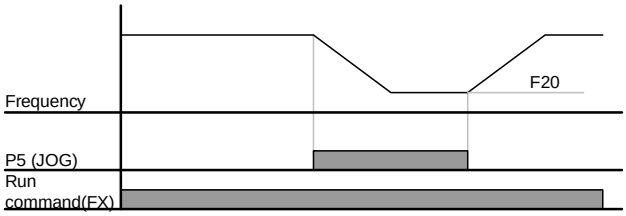
0 = Forward Run (FX) Command: Select to define a digital input as a forward run command in 2-wire or 3-wire control. For both 2-wire and 3-wire control, P38 – Drive Mode should be set to a 1 for normal operation. For 3-wire control an additional terminal must be defined as 17 = 3-wire operation.

1 = Reverse Run (RX) Command: Select to define a digital input as a reverse run command in 2-wire or 3-wire control. For both 2-wire and 3-wire control, P38 – Drive Mode should be set to a 1 for normal operation. For 3-wire control an additional terminal must be defined as 17 = 3-wire operation.

2 = Emergency Stop (BX) Trip: Defines a digital input as a stop command. Drive will stop according to P39 = Stop mode select (ramp deceleration, dc brake or coast to rest).

3 = Fault Reset (RST): When input is present, clears an active fault and resets the drive.

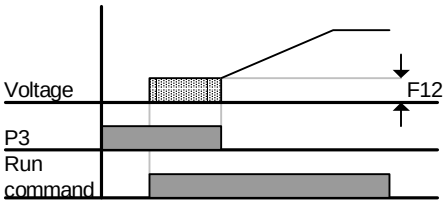
4 = Jog: When input is present, the drive ramps to the value set in Jog Frequency (F20). Jog operation overrides all other operations except Dwell operation. Therefore, if Jog frequency command is entered in the middle of Preset Speed, Up-Down or 2-wire control; operation is executed at jog frequency. A valid start command is required separate from the dedicated jog input. The jog function is only available for 2-wire control.



5 = Preset Speed Input – Bit 1
6 = Preset Speed Input – Bit 2
7 = Preset Speed Input – Bit 3:
Used to select Preset Speed 1 ~ 7 combinations, see preset speed frequencies P43~P45 and t10~t13.

8 = Preset Speed Ramp – Bit 1
9 = Preset Speed Ramp – Bit 2
10 = Preset Speed Ramp – Bit 3:
Used to define accel/decel ramp combinations for preset speeds, see (t14~t27).

11 = DC brake during start: DC voltage will be applied to the motor windings at a level set by DC Brake Start Voltage (F12) for as long as the digital input is closed. See also F12 and F13 – Starting DC brake parameters.



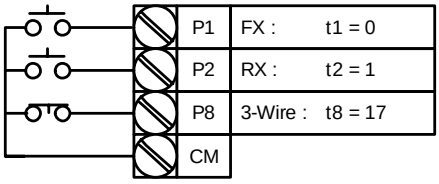
12 = 2nd motor select: When input is present, the drive configures itself for a second set of motor settings defined in 2nd motor operation parameters (H81 to H90).

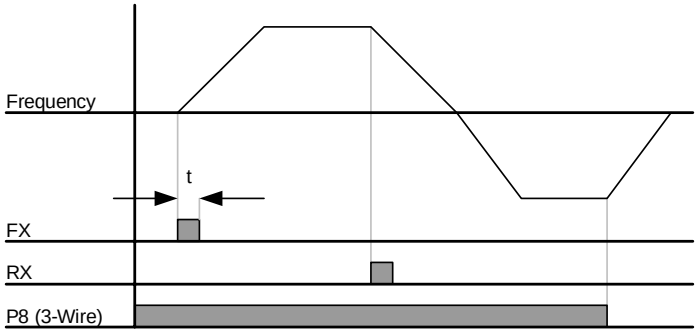
13 = **Reserved**: Reserved
14 = Reserved: Reserved

15 = Frequency increase (UP): Increases the frequency reference to the drive after a run command. Frequency is saved to parameter F64 on a stop command if F63 = 1 'save up/down frequency'.

16 = Frequency decrease (DOWN): decreases the frequency reference to the drive after a run command. Frequency is saved to parameter F64 on a stop command if F63 = 1 'save up/down frequency'.

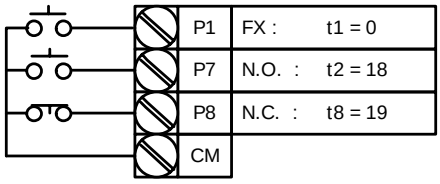
17 = 3-wire operation: Select to define a digital input for 3-wire control. Inputs defined as forward (FX) and reverse (RX) are momentary inputs and opening the input defined as 3-wire operation will stop the drive. For both 2-wire and 3-wire control, P38 – Drive Mode should be set to a 1 for normal operation.

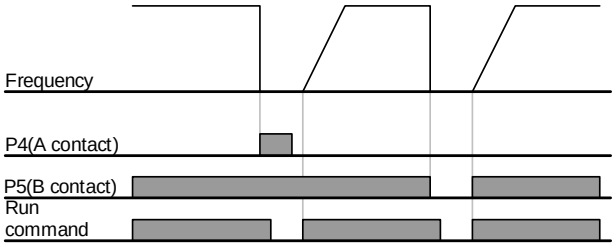




18 = External trip – A (N.O.): Normally open contact input. When a digital input is set to “Ext trip-A” is ON (Closed), the drive displays the fault and turns off its output power.

19 = External trip – B (N.C.): Normally closed contact input. When a digital input is set to “Ext trip-B” is OFF (Open), the drive displays the fault and turns off its output power.



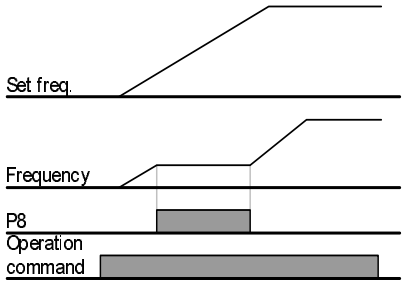


20 = Self-Diagnostic function: Defines a digital input to initiate the self-diagnostic function capability of the drive unit. Parameter H60 = Self-Diagnostic function is used to define the test to conduct; IGBT fault and ground fault, Output phase short/open circuit/ground fault or ground fault (IGBT fault/output phase short/open circuit). See Chapter 8 – Customizing Your Application for advanced drive function description.

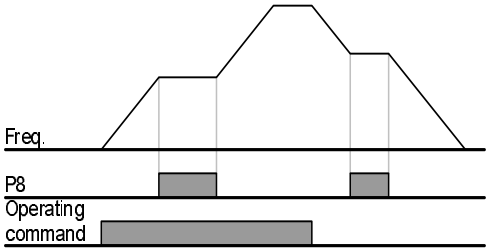
21 = Change from PID to V/Hz Operation: Selects a digital input to bypass the PID Feedback controller and selects the default V/Hz control settings. See Chapter 8 – Customizing your application for advanced drive function.

22 = Change from Option (RS485) to Inverter: When the defined input is turned ON, setting values in drv2 and Frq2 are used for control and reference to the drive. This function is only available when the P38 = Drive mode is programmed for 3 = RS485. Settings for drv2 and Frq2 can not be changed while the digital input is closed.

23 = Analog Hold: Locks the analog speed reference at the last value when the input was closed. Available when P40 = Frequency setting method is set in the range of 2 ~ 7.



24 = Accel/Decel Disable: Disables the acceleration or deceleration ramp while the digital input is closed, holding the reference at its last value.



25 = Up/Down Frequency Save Initialization: When the digital input is active, the last Up/Down frequency is saved. Useable when digital inputs are configured as 15 = Frequency Increase (UP) and 16 = Frequency Decrease (DOWN).

t9 Filtering Time Constant for Multi-function input terminal

Range:	1 - 15
Default:	4
Access	Tunable
See Also:	t1-t8

The higher the value is set, the slower the responsiveness of the digital input becomes.

t10 **Preset Speed 4**

t11 **Preset Speed 5**

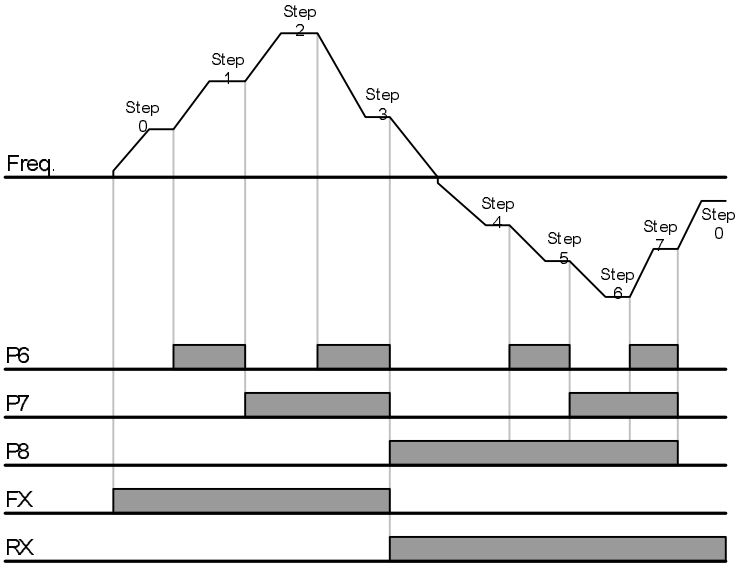
t12 **Preset Speed 6**

t13 **Preset Speed 7**

Range:	0-400 [Hz]
Default:	t10 =30, t11=25, t12=20, t13=15
Access	Tunable
See Also:	t1-t8, P43-P45

Provides a fixed frequency command value when Digital Input 1 ~ 8 is set for a Preset Speed (Option 5, 6 and 7). Closing a digital input programmed as a preset speed will cause the drive to operate at the defined speed. Preset speeds 1~3 are set in the basic parameter group (P43~P45) while preset speeds 4~7 are set in the terminal group (t30~t33).

Parameter	Preset Speed	Preset Speed Input		
		Bit 3	Bit 2	Bit 1
P40	Freq Command	-	-	-
P43	1	-	-	✓
P44	2	-	✓	-
P45	3	-	✓	✓
t30	4	✓	-	-
t31	5	✓	-	✓
t32	6	✓	✓	-
t33	7	✓	✓	✓



t14 **Preset Speed Accel Time 1**

t15 **Preset Speed Decel Time 1**

t16 **Preset SpeedAccel Time 2**

t17 **Preset Speed Decel Time 2**

t18 **Preset Speed Accel Time 3**

t19 **Preset Speed Decel Time 3**

t20 **Preset Speed Accel Time 4**

t21 **Preset Speed Decel Time 4**

t22 **Preset Speed Accel Time 5**

t23 **Preset Speed Decel Time 5**

t24 **Preset Speed Accel Time 6**

t25 **Preset Speed Decel Time 6**

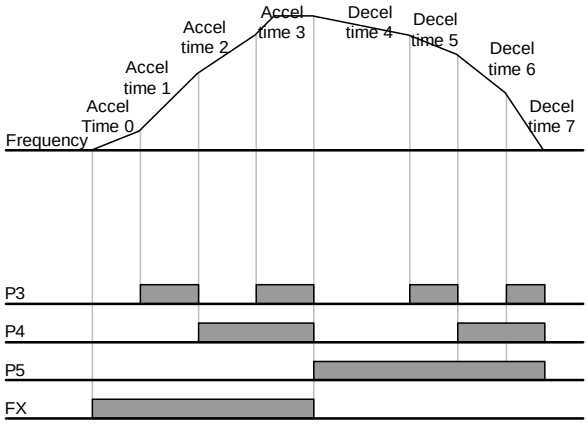
t26 **Preset Speed Accel Time 7**

t27 **Preset Speed Decel Time 7**

Range:	0 - 6000 [Sec]
Default:	t14, t15 = 3.0; t16, t17 = 4.0; t18, t19 = 5.0; t20, t21 = 6.0; t22, t23 = 7.0, t24, t25 = 8.0, t26, t27 = 9.0
Access	Tunable
See Also:	t1-t8, t10-t13, P43-P45

Sets multiple acceleration and deceleration ramps based on a digital input closure.

No.	Accel/ Decel Time	Preset Speed Ramp		
		Bit 3	Bit 2	Bit 1
P41 P42	0	-	-	-
t14 t15	1	-	-	✓
t16 t17	2	-	✓	-
t18 t19	3	-	✓	✓
t20 t21	4	✓	-	-
t22 t23	5	✓	-	✓
t24 t25	6	✓	✓	-
t26 t27	7	✓	✓	✓

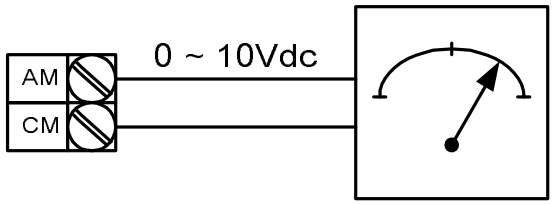


t28 Analog Output Select

Range:	0 - 3
Default:	0
Access	Tunable
See Also:	t29

Selects the value to send to the analog output terminals.

Setting:	10V Output Proportional To:
0 = Output Frequency	P36 – Frequency High Limit
1 = Output Current	150% of Inverter rated current
2 = Output Voltage	282Vac or 564Vac (200V or 400V Drive Rating)
3 = DC Link Voltage	400Vdc or 800Vdc (200V or 400V Drive Rating)



t29 Analog Output Level Adjustment

Range:	10 - 200%
Default:	100
Access	Tunable
See Also:	t28

Adjusts the scaling of the analog output based on a 10V signal.

t30 **Frequency detection level**

t31 **Frequency detection bandwidth**

Range:	0-400 [Hz]
Default:	t30 = 30, t31 = 10
Access	Tunable
See also:	t32-t33

Used when t32 or t33 are set to 0-4, can not be set higher than P36 (Frequency High Limit). See Chapter 8 - Customizing Your Application for more information.

t32 **Digital Output (MO)**

t33 **Relay Output (3A - 3C)**

Range:	0 = FDT-1 1 = FDT-2 2 = FDT-3 3 = FDT-4 4 = FDT-5 5 = Overload (OLt) 6 = Inverter Overload (LoIT) 7 = Motor Stall STALL 8 = Over voltage trip (OV) 9 = Low voltage trip (LV) 10 = Inverter overheat (OH) 11 = Command Loss 12 = During run 13 = During stop 14 = During constant run 15 = During speed searching 16 = Wait time for run signal input 17 = Fault Output 18 = Cooling Fan Trip Alarm
Default:	t32=12, t33=17
Access	Tunable
See Also:	t34, F54-F55, F59-F60

Sets the on/off point for the Digital and Relay outputs. See Chapter 8 – Customizing Your Application for details on this parameter.

t34 **Fault Relay Output**

Range:	0-7
Default:	2
Access	Tunable
See Also:	t33

Outputs a fault code when t33 – Relay Output is set to 17: Fault Output. See Chapter 8 – Customizing Your Application for more information on this parameter.

t35 Criteria for Analog Input Signal Loss

Range:	0 = Disabled 1 = Activated below half of set value 2 = Activated below set value
Default:	0
Access	Tunable
See Also:	t32-t33, t36, t41, t46, t62-t63

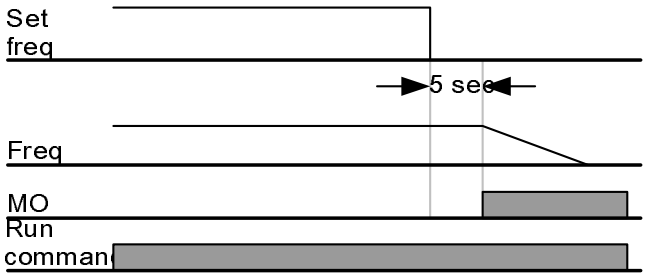
Selects the drive mode when frequency reference set by the Analog (V1, I) input terminal or communication option is lost.

t35	[Criteria for analog input signal loss]	0	Disabled (Does not check the analog input signal loss)
		1	When half the value set in t36, t41, t46 is entered
		2	When less than the value set in t36, t41, t46 is entered

Example 1) The inverter determines the freq reference is lost when P40 – Freq set method is set to 3 (Analog V1 input), t16 to 1 and analog input signal is less than half the value set in t36.

Example 2)The inverter determines the freq reference is lost when P40 – Freq set method is set to 6 (V1+I), t16 to 2 and V1 input signal is either below the value set in t36 or I input value is less than the t46 value.

Example diagram when t35 is set to 2, I62 to 2, I63 to 5.0 sec and t32 to 11:



t36 Analog Input 0 to -10V (NV) Min voltage

Range:	0 to -10V
Default:	0
Access	Tunable
See Also:	P40, t37

Sets the minimum voltage of the NV (-10 to 0V) input.

t37 **Frequency corresponding to t36**

Range:	0 - 400 [Hz]
Default:	0
Access	Tunable
See Also:	t37

Sets the inverter output minimum frequency at minimum voltage of the NV input.

t38 **Analog Input 0 to -10V (NV) Max voltage**

Range:	0 - 10V
Default:	10
Access	Tunable
See Also:	P40, t39

Sets the maximum voltage of the NV input.

t39 **Frequency corresponding to t38**

Range:	0 - 400 [Hz]
Default:	60
Access	Tunable
See Also:	t38

Sets the inverter output maximum frequency at maximum voltage of the NV input.

t40 **Analog Input 0 - 10V (V1) Filter time constant**

Range:	0 - 9999
Default:	10
Access	Tunable
See Also:	P40, t41-t43

Adjusts the responsiveness of the Analog (V1) input (0~+10V) to filter noise.

t41 **Analog Input 0 - 10V (V1) Min voltage**

Range:	0 - 10V
Default:	0
Access	Tunable
See Also:	t40, t42

Sets the minimum voltage of the Analog Input (V1) input.

t42 **Frequency corresponding to t41**

Range:	0 - 400 [Hz]
Default:	0
Access	Tunable
See Also:	t41

Sets the inverter output minimum frequency at minimum voltage of the V1 input.

t43 **Analog Input 0-10V (V1) Max voltage**

Range:	0 - 10V
Default:	10
Access	Tunable
See Also:	t44

Sets the maximum voltage of the V1 input.

t44 **Frequency corresponding to t43**

Range:	0 - 400 [Hz]
Default:	60
Access	Tunable
See Also:	t43

Sets the inverter output maximum frequency at maximum voltage of the V1 input.

t45 **Analog Input 0-20mA (I) Filter time constant**

Range:	0 - 9999
Default:	10
Access	Tunable
See Also:	P40, t46-t49

Adjusts the responsiveness of the Analog (I) input (0-20mA) to filter noise.

t46 **Analog Input 0-20mA (I) Min Current**

Range:	0-20mA
Default:	4
Access	Tunable
See Also:	t45, t47

Sets the minimum current of the Analog 0-20mA (I) Input.

t47 **Frequency corresponding to t46**

Range:	0 - 400 [Hz]
Default:	0
Access	Tunable
See Also:	t46

Sets the inverter output minimum frequency at minimum current of the I input.

t48 **Analog Input 0-20mA (I) Max Current**

Range:	4 - 20mA
Default:	20
Access	Tunable
See Also:	t47

Sets the maximum current of the Analog 0-20mA (I) Input.

t49 **Frequency corresponding to t47**

Range:	0 - 400 [Hz]
Default:	60
Access	Tunable
See Also:	t48

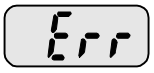
Sets the inverter output maximum frequency at maximum current of the I input.

t57 **Keypad Error Output**

Range:	0 - 3
Default:	0
Access	Tunable

	Relay Output Bit 2	Digital Output Bit 0
0	-	-
1	-	✓
2	✓	-
3	✓	✓

Selects the Digital and/or Relay output when a keypad-inverter communication fails.

When communication error occurs for a certain time, 

will be displayed and the error signal can be sent to the Digital (MO) or Relay output.

0: Not used
1: Signal output to MO
2: Signal output to 3A, 3B contacts
3: Signal output to MO, 3A, 3B

t59 Communication protocol select

Range:	0=Modbus RTU 1=LS BUS
Default:	0
Access	Configurable
See Also:	t60-t61, t64-t81

Sets the protocol for the serial communication network.

t60 Inverter Number

Range:	1-250
Default:	1
Access	Tunable
See Also:	t59, t61, t64-t81

Sets the drive node address for the RS485 port multi-drop network.

t61 Baud Rate

Range:	0=1200 [bps] 1=2400 [bps] 2=4800 [bps] 3=9600 [bps] 4=19200 [bps]
Default:	3
Access	Tunable
See Also:	t59-t60, t64-t81

Selects the Baud Rate of RS485 Communication.

t62 Frequency Loss Mode

Range:	0=Continue operation at last frequency command 1= Coast to Stop. 2= Decelerate to stop.
Default:	0
Access	Tunable
See Also:	P40, t35, t63

When the frequency reference is from the Analog Input or RS485 Port, this parameters sets the action to take if the speed reference is lost.

t63 Frequency Loss Wait Time

Range:	0.1-120 [sec]
Default:	1.0
Access	Tunable
See Also:	P40, t35, t62

This is the time delay before the drive takes action in the event of a command frequency loss. If there is no frequency command input during the time set in this parameter, the drive starts to operate in the mode selected in t62.

t64 Communication Time Setting

Range:	2-100 [ms]
Default:	5
Access	Tunable
See Also:	t59-t61, t65-t81

Frame Communication time.

t65 Parity/Stop Bit Setting

Range:	0=Parity: None, Stop Bit: 1 1=Parity: None, Stop Bit: 2 2=Parity: Even, Stop Bit: 1 3=Parity: Odd, Stop Bit: 1
Default:	0
Access	Tunable
See Also:	t59-t61, t64, t66-t81

When the protocol is set, the communication format can be set.

t66 Read address register 1
t67 Read address register 2
t68 Read address register 3
t69 Read address register 4
t70 Read address register 5
t71 Read address register 6
t72 Read address register 7
t73 Read address register 8

Range:	0-42239
Default:	t66=5, t67=6, t68=7, t69=8, t70=9, t71=10, t72=11, t73=12
Access	Tunable

The user can register up to 8 discontinuous addresses and read them all with one read command.

t74 **Write address register 1**

t75 **Write address register 2**

t76 **Write address register 3**

t77 **Write address register 4**

t78 **Write address register 5**

t79 **Write address register 6**

t80 **Write address register 7**

t81 **Write address register 8**

Range:	0-42239
Default:	t74=5, t75=6, t76=7, t77=8, t78=5, t79=6, t80=7, t81=8
Access	Tunable

The user can register up to 8 discontinuous addresses and read them all with one read command.

7.5 Function Group 1 Parameters

F0 Jump Code

Range:	0-64
Default:	0
Access	Tunable

Sets the code to jump directly to a specific parameter within the group.

F1 Forward/Reverse Run Disable

Range:	0 = Forward and Reverse run enable 1 = Forward run disable 2 = Reverse run disable
Default:	0
Access	Configurable

Enables/disables the function that allows the direction of the motor rotation to be changed. The forward or reverse command may come from a digital command, the keypad or serial command. All forward or reverse inputs will be ignored if the corresponding directional control is disabled in F1.

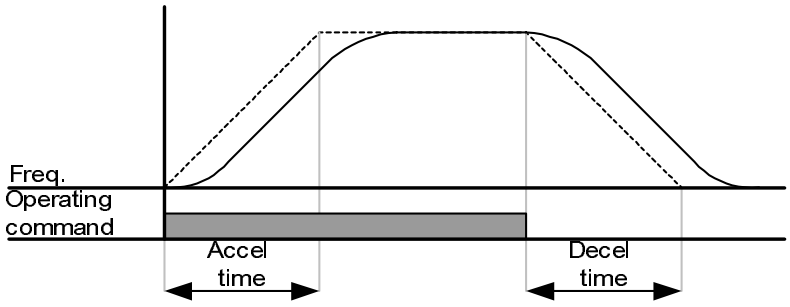
F2 Accel Pattern

F3 Decel Pattern

Range:	0=Linear 1=S-Curve
Default:	0
Access	Configurable
See Also:	H17, H18, t1-t8

Sets the acceleration and deceleration pattern in the drive.

Linear: General pattern for constant torque applications.
S-Curve:This curve allows the motor to accelerate and decelerate smoothly.

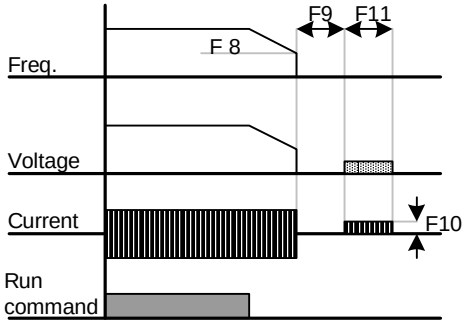


To adjust the slope of the S-Curve see parameters H17 and H18.

F8 **DC Brake start frequency**

Range:	0.1-60 [Hz]
Default:	5.00
Access	Configurable
See Also:	P35,P39, F8-F11
Note:	Only viewable when P39 – Stop mode select is set to DC Brake.

Establishes the DC brake start frequency, it can not be set below P35 – Frequency low limit. Setting this value too high may cause an over current trip. It can be prevented by adjusting F9 – DC Brake wait time.



F9 **DC Brake wait time**

Range:	0-60 [sec]
Default:	0.1
Access	Configurable
See Also:	P35, P39, F8-F11
Note:	Only viewable when P39 – Stop mode select is set to DC Brake.

The drive will hold for the time set in F9 after F8 – DC Brake start frequency is reached before it applies the voltage level set in F10 – DC Brake Voltage. Use DC Brake wait time when the load inertia is large to prevent nuisance trips or damage to the motor.

F10 **DC Brake Voltage**

Range:	0-200 [%]
Default:	50
Access	Configurable
See Also:	P32,P35, P39, F8-F11
Note:	Only viewable when P39 – Stop mode select is set to DC Brake.

Sets the DC Brake Voltage as a percent of P32 – Motor Rated Current.

F11 DC Brake Time

Range:	0-60 [sec]
Default:	1.0
Access	Configurable
See Also:	P35, P39, F8-F11
Note:	Only viewable when P39 – Stop mode select is set to DC Brake.

Sets the time for F10 – DC Brake Voltage to be applied to the motor after F9 – DC Brake wait time. Setting F10 or F11 to zero will disable the DC Brake function. In case of DC Brake at high load inertia and frequency, change the DC brake controller gain according to H37 set value.

F12 DC Brake start voltage

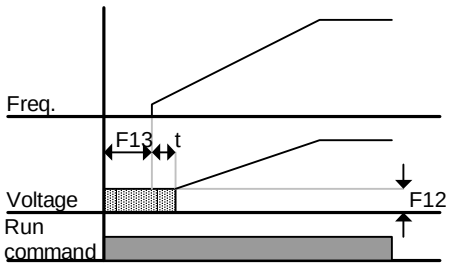
Range:	0-200 [%]
Default:	50
Access	Configurable
See Also:	F12, t1-t8

This parameter sets the amount of DC voltage before a motor starts to run. It is set as percentage of P33 – Motor rated current.

F13 DC Brake start time

Range:	0-60 [sec]
Default:	0
Access	Configurable
See Also:	F12, t1-t8

DC voltage is applied to the motor for DC Brake start time before motor accelerates.



Setting F12 or F13 to 0 will disable the Starting DC brake. After F13 – DC Brake start time, the frequency is increased. If a digital input (t1~t8) is set for 11 – DC brake during start, the voltage is not released until the input is opened. The drive will accelerate with dc voltage applied until the input is open.

F14 Time for magnetizing a motor

Range:	0-60 [sec]
Default:	0.1
Access	Configurable
See Also:	P30, P32, H32, H34, H40, H42, H44

This parameter accelerates the motor after pre-exciting the motor for the set time. The amount of the pre-exciting current is set in H34 – Motor no load current.

F20 Jog Frequency

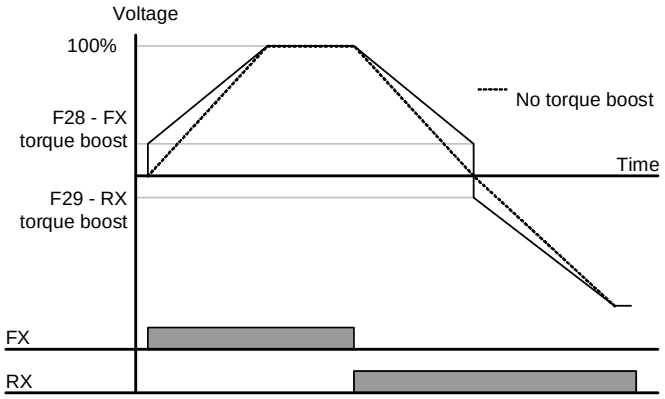
Range:	0-400 [Hz]
Default:	10.00
Access	Tunable
See Also:	P36, t1-t8

This parameter sets the Jog Frequency, it cannot be set above P36 – Frequency High Limit. Jog is only available in 2-wire control mode.

F27 Torque Boost select

Range:	0=Manual Torque Boost 1=Auto Torque Boost
Default:	0
Access	Configurable
See Also:	F28-F29, H34, H41-42

If F27 = 0, set manual torque boost values in F28 and F29.



If F27 = 1 (Auto toque boost), the inverter automatically calculates torque boost values using motor parameters and outputs the corresponding voltage. Before enabling Auto torque boost, H34 – No load current and H42 – Stator resistance must be set properly.

F28 Torque boost in forward direction

F29 Torque boost in reverse direction

Range:	0-15 [%]
Default:	2
Access	Configurable
See Also:	F27-F29

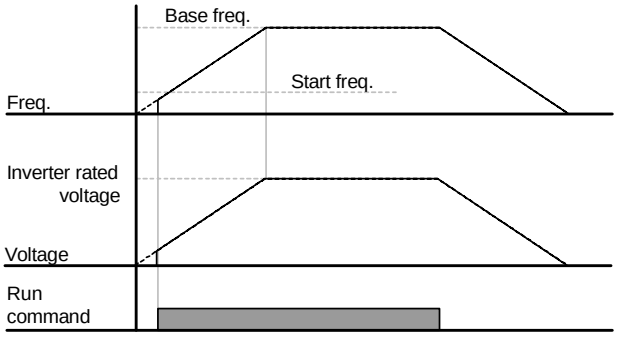
This parameter sets the amount of torque boost applied to a motor during forward or reverse run. It is set as a percent of maximum output voltage.

F30 V/F Pattern

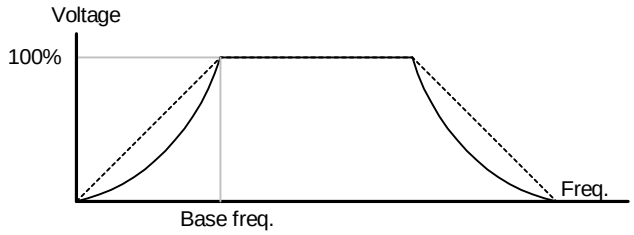
Range:	0=Linear 1=Square 2=User V/F
Default:	0
Access	Configurable
See Also:	P34, P35, F31-F38, H40

Selects a pattern for the drive.

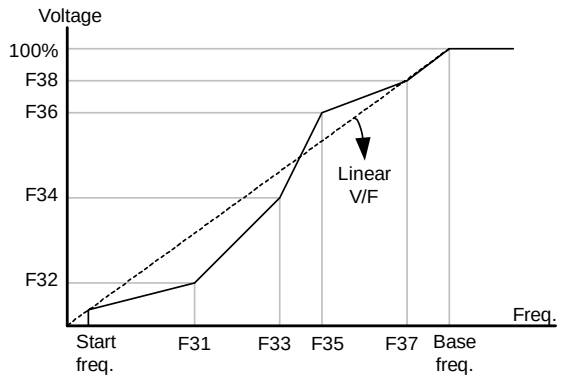
0 = Linear volts per hertz ratio from P35 – Frequency low limit to P34 – Base frequency.



1 = Squared volts per hertz ratio. Applications are fans, pumps or variable torque.



2 = User V/F is a custom volts per hertz pattern established using parameters F31~F38.



F31 **User V/F frequency 1**

F33 **User V/F frequency 2**

F35 **User V/F frequency 3**

F37 **User V/F frequency 4**

Range:	0 - 400 [Hz]
Default:	F31=15, F33=30, F35=45, F37=60
Access	Configurable
See Also:	P34, P35, F31-F38, H40

When F30 = 2, selects the frequency for each point in a custom volts per hertz pattern.

F32 **User V/F voltage 1**

F34 **User V/F voltage 2**

F36 **User V/F voltage 3**

F38 **User V/F voltage 4**

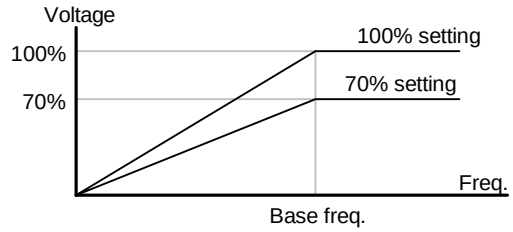
Range:	0-100 [%]
Default:	F32=25,F34=5-, F36=75, F38=100
Access	Configurable
See Also:	P34, P35, F31-F38, H40

When F30 = 2, selects the voltage for each point in a custom volts per hertz pattern.

F39 Output voltage adjustment

Range:	40-110 [%]
Default:	100
Access	Configurable

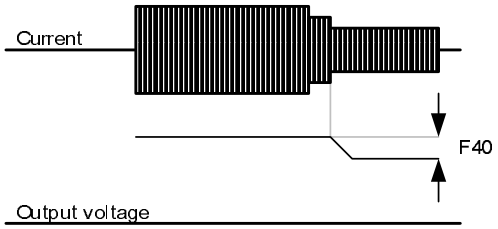
This parameter adjusts the amount of output voltage, set as a percentage of input voltage. Use when the motor voltage is less than the input voltage.



F40 Energy Savings Level

Range:	0-30 [%]
Default:	0
Access	Tunable

This parameter adjusts decreases the output voltage according to load status. It is set as a percent of the maximum output voltage. When used on pump and fan applications, it can dramatically reduce energy consumption by decreasing the output voltage with light loads.



F50 Electronic thermal select

Range:	0 - 1
Default:	0
Access	Tunable
Read Only:	F51-F53

Setting this parameter to a 1 enables the electronic thermal overload. It activates when the motor is overheated if current is greater than the value set in F51 (time-inverse), and the drive output is turned off for the preset time.

Only viewable when F50 = 1 (Electronic Thermal Overload).

F51 **Electronic thermal level for 1 minute**

Range:	50-200 [%]
Default:	150
Access	Tunable
See Also:	F50, F52-F53

This parameter sets the maximum current capable of flowing to the motor continuously for 1 minute. The set value is a percentage of P32 – Motor Rated Current. It can not be set lower than F52 – Electronic thermal level for continuous.

F52 **Electronic thermal level for continuous**

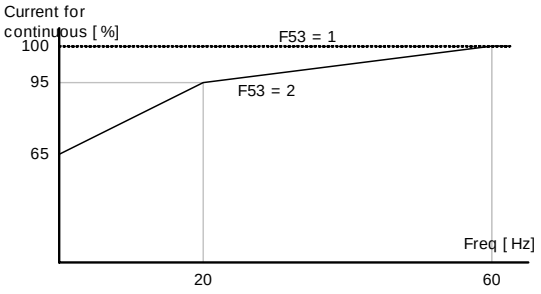
Range:	50-15 [%]
Default:	10
Access	Tunable
See Also:	F50, F51, F53

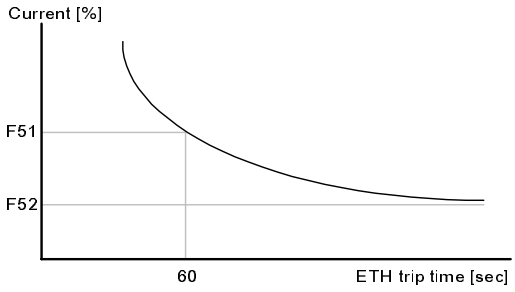
This parameter sets the amount of current to keep the motor running continuously. It cannot be set higher than F51 – Electronic thermal level for 1 minute.

F53 **Motor cooling method**

Range:	0 = Standard Motor 1 = Variable Speed Motor
Default:	00
Access	Tunable

For a Standard Motor, cooling effects decrease when a motor is run at low speed. A Variable Speed motor is a special motor that uses a separately powered cooling fan to maximize cooling effect even at low speed.





F54 Overload Warning Level

Range:	30-150 [%]
Default:	150
Access	Tunable
See Also:	P32, t32, t33, F55

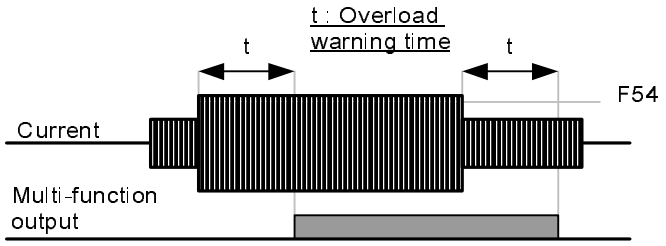
Sets the amount of current to issue an alarm signal at a relay or digital output terminal (see parameters t32 and t33). The value is set as a percentage of P32 – Motor Rated Current.

Select an output terminal for this function between MO (Digital Output) and 3A~C (Relay Output). If selecting MO as the output terminal, set t32 = 5 (Overload: OL).

F55 Overload warning time

Range:	0-30 [sec]
Default:	10
Access	tunable
See also:	P32, t32,t33, F54

This parameter issues an alarm signal when the current greater than F54 – Overload warning level flows to the motor for F55 – Overload warning time.



F56 Overload trip enable

Range:	0 - 1
Default:	1
Access	Tunable
See Also:	F57, F58

When set to a 1 = enabled, this parameter turns off the inverter output when the motor is overloaded. Overload level and time are set in F57 and F58 respectively.

F57 Overload trip level

Range:	30-200 [%]
Default:	180
Access	Tunable
See Also:	P32, F56, F58

This parameter sets the amount of overload current before the drive trips. The value is a percentage of P32 – Motor rated current.

F58 **Overload trip time**

Range:	0-60 [sec]
Default:	60
Access	Tunable
See Also:	F56, F57

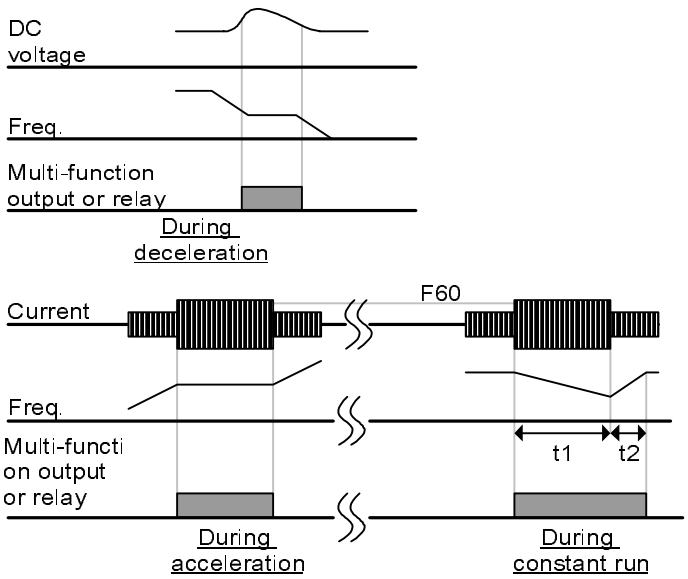
The inverter output is turned off if the current level set in F57 is exceeded for the time set in F58 – Overload trip time.

F59 **Stall Prevention select**

Range:	0 - 7
Default:	0
Access	Configurable
See Also:	t32, t33, F60

	During Decel Bit 2	During Constant Run Bit 1	During Accel Bit 0
0	-	-	-
1	-	-	✓
2	-	✓	-
3	-	✓	✓
4	✓	-	-
5	✓	-	✓
6	✓	✓	-
7	✓	✓	✓

During:	Function Description:
Acceleration	Motor starts deceleration when current exceeds the value set in F60.
Constant run	Motor decelerates when current exceeds the value set in F6.
Deceleration	Motor deceleration is stopped when inverter DC link voltage rises above a certain voltage level.
t32 and t33:	The drive outputs signals through either the digital (MO) or relay output (3A~C) terminals when set = 7 Motor Stall. Motor stall status can be monitored in the above codes even if F59 is not active.
Example:	F59 = 3; stall prevention active during acceleration and constant run. When stall prevention is executed during acceleration or deceleration, accel/decel times may take longer than the user-setting time to prevent a stall condition. When stall prevention is activated during constant run, t1, t2 executed in accordance with the value set in P41 – Accel Time and P42 – Decel Time.



F60 Stall prevention level

Range:	30-200 [%]
Default:	150
Access	Configurable
See Also:	P32, F59

This parameter sets the amount of current to activate stall prevention during acceleration, constant run or deceleration. The value set is a percentage of P32 – Motor Rated Current.

F63 Save Up/down frequency

Range:	0 -1
Default:	0
Access	Configurable
See Also:	t1-t8,F64

This parameter decides whether to save the specified frequency during up/down operation. When 1 is selected, the up/down frequency is saved in F64.

F64	Saved up/down frequency	
	Range:	n/a
	Default:	0.00
	Access	Read Only
	See also:	t1-t8, F63
	Notes:	F64 viewable when F63 = 1 (Save up/down frequency)

Stores the up/down frequency if F63 = 1 before the drive stops or decelerates.

F65	Start Frequency	
	Range:	0.10 to 10.00 [Hz]
	Default:	0.5
	Access	Configurable

The drive starts to output its voltage at this frequency. It is the low frequency limit.

7.6 Function Group 2 Parameters

H0 Jump Code

Range:	0 - 95
Default:	0
Access	Tunable

Sets the code to jump directly to a specific parameter within the group.

H1 Last Fault 1
H2 Last Fault 2
H3 Last Fault 3
H4 Last Fault 4
H5 Last Fault 5

Range:	n/a
Default:	0
Access	Read Only
See also:	H6

Stores information on the types of faults, the frequency, the current and the Accel/Decel condition at the time of fault. The latest fault is automatically stored in the H1 – Fault History 1. Up to the last five faults can be stored. When a fault occurs during operation, it can be monitored in the d – display parameters under nOn. See Chapter 9 – Troubleshooting for information on fault codes and actions.

H6 Reset Fault History

Range:	0 - 1
Default:	0
Access	Tunable
See also:	H1-H5

Clears the fault history saved in H1 to H5.

H7 **Dwell Frequency**

Range:	0.1-400 [Hz]
Default:	5.00
Access	Configurable
See also:	P35, P36, H8

When run frequency is issued, the motor will accelerate after the Dwell Frequency is applied for the Dwell Time – H8. Dwell frequency can be set within Frequency High and Low Limits (P35 and P36).
Dwell frequency is used to output torque in an intended direction. It is useful in hoisting applications to apply torque before releasing a mechanical brake. Rated slip frequency is calculated by the formula shown below:

$$f_s = f_r - \left(\frac{rpm \times P}{120} \right)$$

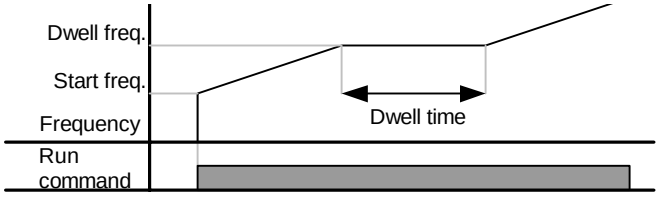
Where, f_s = Rated slip frequency

f_r = Rated frequency rpm = = Motor nameplate RPM

P = Number of Motor poles

Example:
Rated frequency = 60Hz; Rated RPM = 1740rpm;
Number of motor poles= 4

$$f_s = 60 - \left(\frac{1740 \times 4}{120} \right) = 2Hz$$



H8 **Dwell Time**

Range:	0-10 [sec]
Default:	0.0
Access	Configurable
See also:	H7

Sets the time for dwell operation.

H10 Skip Frequency Enable

Range:	0 - 1
Default:	0
Access	Configurable
See also:	H11-H16

Set this parameter = 1 to enable the skip frequency settings configured in H11 thru H16. When it is desirable to avoid resonance attributable to the natural frequency of a mechanical system, these parameters allow resonant frequencies to be skipped. Three different areas of Skip frequency High/Low limit can be set. During acceleration or deceleration however, the run frequency within the set area is valid.

H11 Skip Frequency Low Limit 1

H12 Skip Frequency High Limit 1

H13 Skip Frequency Low Limit 2

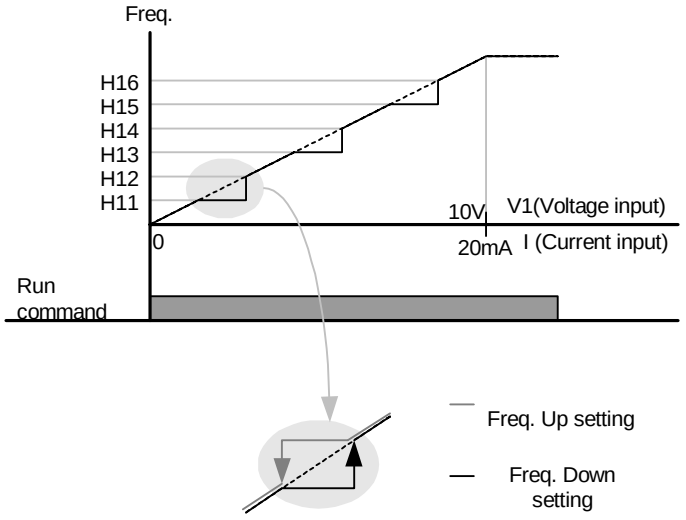
H14 Skip Frequency High Limit 2

H15 Skip Frequency Low Limit 3

H16 Skip Frequency High Limit 3

Range:	0.1-400 [Hz]
Default:	H11=10, H12=15, H13=20, H14=25, H15=30, H16=35
Access	Configurable
See Also:	H10
Note:	Parameters H11-H16 are only viewable when H10 – Skip Frequency = 1 (Enabled).

Run frequency cannot be set within the range of H11 thru H16. The frequency values of the low numbered parameters cannot be set above those of the high numbered ones. Settable within the range of Frequency High and Low Limits (P35 and P36).Sets the lower limit of frequency range 1 to skip.



Case 1:If frequency set value (Analog setting via voltage, current, RS485 or keypad) is within the range of skip frequency, it maintains the low limit value. If the set value is outside the range, it increases the frequency up to the set value.

Case 2:In the case of a decreasing frequency setting, if the frequency set value (Analog setting via voltage, current, RS485 or keypad) is within the range of skip frequency, it maintains skip frequency high value. If the setting is outside the range, it decreases frequency to the set value.

H17 S-Curve Accel/Decel Start Side

H18 S-Curve Accel/Decel End Side

Range:	0.1-100 [%]
Default:	40
Access	Configurable
See also:	P41, P42, F2, F3

Set the speed reference value to form a curve at the start and end cycle of the acceleration and deceleration curves. If it is set higher, linear zone gets smaller.

H17 sets the starting and H18 the ending ratio between S-curve and Linear in ½ of Accel/Decel Ref. Frequency. For smooth Accel/Decel starting, increase H17 or H18 to extend the S-curve ratio.

Note that setting Frequency Ref. for Accel/Decel (H70) is set to Max Freq and target freq is set below Max freq. the shape of the S-curve may be distorted.

Accel time for S-curve setting $= P41 + P41 \times \frac{H17}{2} + P41 \times \frac{H18}{2}$

Decel time for S-curve setting: $= P42 + P42 \times \frac{H17}{2} + P42 \times \frac{H18}{2}$

H19 Phase Loss Protection

Range:	0 - 3n
Default:	0
Access	Tunable

Setting H19 to a value other than 0 enables Phase Loss Protection.

Output Phase Loss: Inverter output is shut off in the event of more than one phase loss among U, V and W.

Input Phase Loss: Inverter output is blocked at the event of more than one phase loss among R, S and T. If there is no input phase loss, output is shut off when it is time to replace the DC link capacitor.

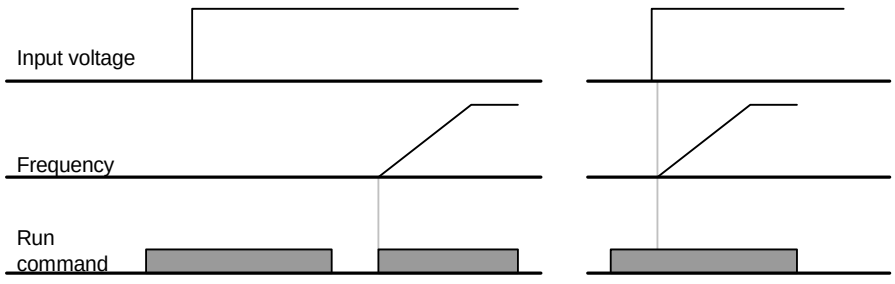
Note: Set P32 – Motor Rated Current correctly. If the actual motor rated current and the value of P32 are different, output phase loss protection function may not activate correctly.

0 = Not Used
1 = Output phase loss protection
2 = Input phase loss protection
3 = Input/output phase loss protection

H20 Power On Start

Range:	0 - 1
Default:	0
Access	Tunable
See also:	P38

Setting H20 = 1 enables power on start. This parameter is activated when P38 – Drive Mode is set to 1 or 2 (Run/Stop via Control Terminal). Motor will accelerate after AC power is applied and a Forward Run (FX) or Reverse Run (RX) terminal is ON.



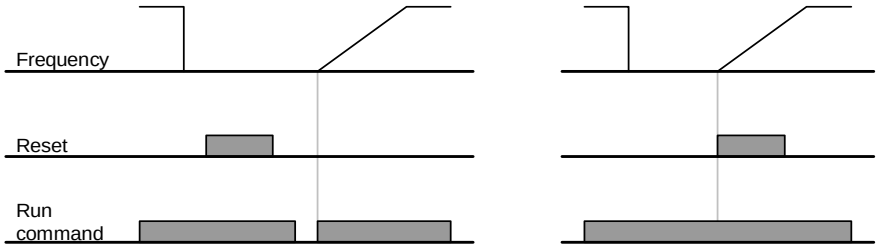
This parameter is inactive if P38 – Drive Mode is set to Keypad or RS485.

ATTENTION: Particular attention must be directed to this function due to potential hazard as motor starts to run suddenly upon applying AC input power.

H21 **Auto Restart**

Range:	0 - 1
Default:	0
Access	Tunable
See also:	P38, H26, H27

Setting H21 = 1 enables auto restart. This parameter is activated when P38 – Drive Mode is set to 1 or 2 (Run/Stop via Control Terminal). Motor will accelerate after a fault condition is reset. A Forward Run (FX) or Reverse Run (RX) terminal must be ON to Auto Restart.



When H21 is 0 When H21 is 1

ATTENTION: Particular attention must be directed to this function due to potential hazard as motor starts to run suddenly after the fault is cleared.

H22 **Speed Search Select**

Range:	0 - 15
Default:	0
Access	Configurable
See also:	t32, t33, H23-H27

This parameter is active to prevent any possible fault when the inverter outputs its voltage to the running motor. See Chapter 8 – Customizing Your Application for details on setting this parameter.

H23 **Spped Search Current Level**

Range:	80 - 200 [%]
Default:	100
Access	Tunable
See also:	P32, H22, H24-H27

This parameter limits the amount of current during speed search. The value is a percentage of P32 – Motor Rated Current. See Chapter 8 – Customizing Your Application for details on setting this parameter.

H24 **Speed Search P Gain**

H25 **Speed Search I Gain**

Range:	0-9999
Default:	100
Access	Tunable

Settings H24 and H25 are used to set the Proportional and Integral gain used for Speed Search PI Controller. See Chapter 8 – Customizing Your Application for details on setting this parameter.

H26 **Auto Restart Attempts**

Range:	0-10
Default:	0
Access	Tunable
See Also:	H21, H27

This parameter sets the number of restart tries after a fault occurs. Auto restart becomes active after the time is reached in H27 – Auto Restart Time. Auto Restart is deactivated if the number of faults exceeds the value in H26 – Auto Restart Attempts.

H26 is reset back to its entered value if STOP key or a reset via the control terminal is activated. If no trip occurs for 30 seconds after the auto restart operation, H26 is reset.

It is not possible to restart (auto restart becomes deactivated) if the drive faults due to a Low Voltage (Lvt), Emergency Stop (EST), Inverter Overheat (Oht) or a Hardware Trip (HWt) fault. This parameter sets the number of restart tries after a fault occurs. Auto restart becomes active after the time is reached in H27 – Auto Restart Time. Auto Restart is deactivated if the number of faults exceeds the value in H26 – Auto Restart Attempts.

H27 **Auto Restart Time**

Range:	0-60 [sec]
Default:	1.0
Access	Tunable
See Also:	H21, H27

This parameter sets the amount of time between auto restart attempts. After the Auto Restart Time, the motor starts acceleration automatically.

H32 **Slip Frequency**

Range:	0-10 [Hz]
Default:	1.67
Access	Configurable
See Also:	P33, H40

Enter the slip frequency in accordance with the following formula and motor nameplate.

$$f_s = f_r - \left(\frac{rpm \times P}{120} \right)$$

Where:

f_S = Rated Slip Frequency

f_r = Rated Frequency

rpm = Motor Nameplate rpm

P = Number of Motor Poles

Example: Rated Freq: 60 Hz; Rated RPM: 1740 rpm; Poles: 4
fs = 60 - ((1740 x 4) / 120) = 2 HZ

H34 **No Load Motor Current**

Range:	0.1-20 [A]
Default:	Based on drive rating
Access	Configurable

Enter the current value detected when the motor is rotating at rated speed (remove any load connected to the motor shaft). For applications where it is difficult to measure the no load current, enter a value of 50% of the rated nameplate motor current in this parameter.

H36 **Motor Efficiency**

Range:	50-100 [%]
Default:	87
Access	Configurable

Enter the motor efficiency from the motor nameplate.

H37 Load Inertia Rate

Range:	0=Load inertia rate is less than 10 times that of motor inertia 1=Load inertia rate equal to approximately 10 times the motor inertia. 2=Load inertia rate is more than 10 times that of motor inertia.
Default:	0
Access	Configurable
See also:	F8-F11, H40

Select range according to the connected inertia in relationship to the motor inertia.

H39 Carrier Frequency Select

Range:	2-15 [kHz]
Default:	2
Access	Tunable

This parameter affects the audible sound of the motor, noise emission form the inverter, inverter temperature, and leakage current. If the set value is higher, the inverter sound is more quiet, but the noise from the inverter and leakage current will be increased.

H40 Control Mode Select

Range:	0=Volts/Frequency Control 1=Slip Compensation Control 2=PID Feedback Control 3=Sensorless Vector Control
Default:	0
Access	Configurable

This parameter selects the control mode for the operation of the drive. See the following description of control method and the corresponding parameters for adjustment to each.

Volts per Hertz:	Basic Operation of the Drive, set standard motor parameters: P30 – Motor Hp P32 – Motor Rated Current P33 – Motor PolesF30 – V/F Pattern
Slip Compensation:	This function enables the motor to run in constant speed by compensating inherent slip in an induction motor. Set parameters: P30 – Motor Hp P32 – Motor Rated Current P33 – Motor Poles H32 – Rated Slip Freq H34 – Motor No Load Current H36 – Motor Efficiency H37 – Load Inertia
PID Feedback:	H50 thru H56 (see chapter 8 for advanced PID features)
Sensorless Vector:	Open Loop Speed Regulated drive control. Set parameters: P30 – Motor Hp P32 – Motor Rated Current H32 – Rated Slip Freq H34 – Motor No Load Current H41 – Auto tuning H42 – Stator resistance H44 – Leakage inductance F14 – Time for magnetizing

H41 Auto-Tuning

Range:	0 - 1
Default:	0
Access	Configurable
See also:	H40, H42, H44

If this parameter is set to a 1, it automatically measures the values to assign for parameters H42 – Stator Resistance and H44 – Leakage Inductance.

H42 Stator Resistance (Rs)

Range:	0-28 [Ω]
Default:	n/a
Access	Configurable
See also:	H40, H41, H44

This is the value of the motor stator resistance.

H44 **Leakage Inductance (Lσ)**

Range:	0-300.0 [mH]
Default:	Based on drive rating
Access	Configurable
See also:	H40, H41, H42

This is the leakage inductance of the stator and rotor of the motor.

H45 **Sensorless P Gain**

H46 **Sensorless I Gain**

Range:	0-32767
Default:	H44=1000, H45=100
Access	Configurable
See also:	H40
Note:	Set H40 = 3 (Sensorless Vector Control) to display these parameters.

Proportional and Integral gain for Sensorless Vector Control.

H50 **PID Feedback Selection**

Range:	0=Terminal I Input (0-20 mA) 1=Terminal V1 Input (0-10V)
Default:	Based on drive rating
Access	Configurable
See Also:	H40, H50-H56

Selects the source for the PID loop feedback.

H51 **P Gain for PID**

Range:	0 - 999.9%
Default:	300.0
Access	Configurable
See Also:	H40, H50-H56

These parameter sets the Proportional gain for the PID Controller.

H52 **I Gain for PID**

Range:	0.1-32.0[sec]
Default:	1.0
Access	Tunable
See Also:	H40, H50-H56

These parameter sets the Integral gain for the PID Controller.

H53 **D Gain for PID**

Range:	0-30.0[sec]
Default:	0.0
Access	Tunable
See Also:	H40, H50-H56

These parameter sets the Differential gain for the PID Controller.

H54 **F Gain for PID**

Range:	0-999.9[%]
Default:	0.0
Access	Tunable
See Also:	H40, H50-H56

This is the Feed forward gain for the PID controller.

H55 **PID output frequency high limit**

H56 **PID output frequency low limit**

Range:	0.1-400[Hz]
Default:	60.00
Access	Tunable
See Also:	H40, H50-H56

These parameters set the limits for the output frequency through the PID control.

H60 **Self Diagnostics Select**

Range:	0 - 3
Default:	0
Access	Configurable
See Also:	t1-t8

0 = Self-diagnostic disabled
1 = IGBT fault/ground fault
2 = Output phase short & open/ground fault
3 = Ground Fault

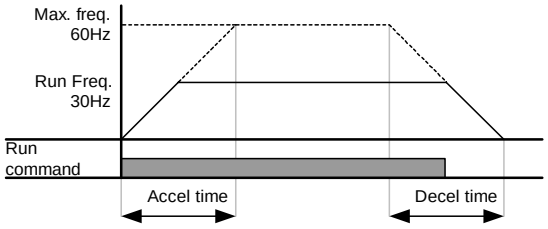
H70 Frequency Reference for Accel/Decel

Range:	0 - 1
Default:	0
Access	Configurable
See Also:	P36, P41, P42, H71

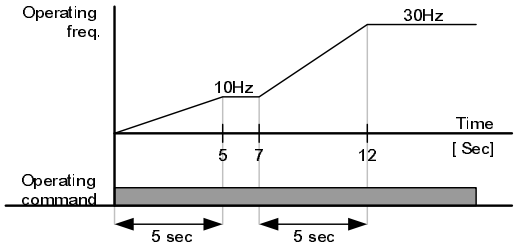
0 = Based on P36 – Frequency High Limit
1 = Based on Delta Frequency

Set the desired Accel/Decel time sin P41 and P42. If H70 = 0, the acceleration and deceleration time is the time that it takes to reach maximum frequency from 0 hertz. If you set H70 to 1 = Delta Frequency, Accel/Decel time is the time that it takes to reach target frequency from a constant run frequency (current operating frequency). To scale the time units for accel/decel set parameter H71.

H70 = 0 (Max Frequency)



H70 = 1 (Delta Frequency)



H71 Accel/Decel Time Scale

Range:	0 - 2
Default:	1
Access	Tunable
See Also:	P36, P41, P42, H70

This parameter is used to scale the time units for the accel/decel ramp. The display for the VS1MD is available up to 5-digits. Therefore, if time unit is set to 0.01 sec for example, maximum accel/decel time would be 600.00 seconds.

0 = Setting Unit: 0.01 sec	Range: 0.01 ~ 600.00
1 = Setting Unit: 0.1 sec	0.1 ~ 6000.0
2 = Setting Unit: 1 sec	1 ~ 60000

H72 Power-On Display

Range:	0 - 9
Default:	0
Access	Configurable
See Also:	d0-d9, H74

This parameter selects the parameter to display on the keypad when power is applied.

0 = Frequency Command	1 = Motor RPM
2 = Output Current	3 = Output Voltage
4 = Output Power	5 = Output Torque
6 = DC Link Voltage	7 = Digital Input Status
8 = Digital Output Status	9 = Software Version

H74 Gain for Motor RPM Display

Range:	1-100 [%]
Default:	100
Access	Configurable
See Also:	d1, H72

This parameter is used to change the motor rpm display to a scaled custom factor. When H40 = 0 (V/F Control) or 1 (PID Control), the inverter output frequency is displayed in RPM suing the formula below. Motor slip is not considered.

$$RPM = \left(\frac{120 \times f}{P32} \right) \times \frac{H74}{100}$$

H75 DB Resistor Select

Range:	0 - 1
Default:	1
Access	Configurable
See Also:	H76

0 = Unlimited
1 = Limited by setting in H76

ATTENTION: Take caution when DB resistor is used over its Watt rating. Fire may result from resistor overheat. When resistor having heat detection sensor is used, sensor output can be used as external trip signal in digital input.

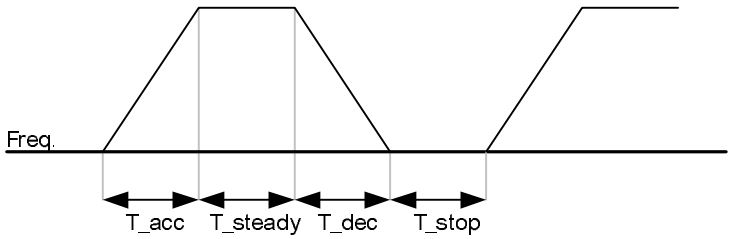
H76 DB Resistor Operating Rate

Range:	0-30[%]
Default:	10
Access	Configurable
See Also:	H75

Sets the percent of DB resistor operating rate to be activated during one sequence of operation. Continuous usage rate is a maximum of 15 seconds.
Example 1)

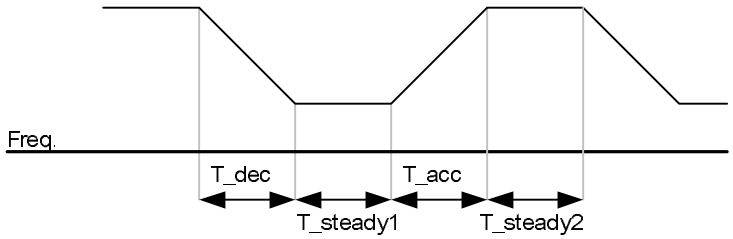
$$H76 = \frac{T\_dec}{T\_acc + T\_steady + T\_dec + T\_stop} \times 100[\%]$$

T_acc: Acceleration time to reach a setting freq.
T_steady: Time for constant speed operation at setting freq.
T_dec: Time to decelerate to lower freq. than that in constant speed or time to stop from freq. in constant speed.
T_stop: waiting time at a stop before operation is resumed.



Example 2)

$$H76 = \frac{T\_dec}{T\_dec + T\_steady1 + T\_acc + T\_steady2} \times 100[\%]$$



H77 Cooling Fan Control

Range:	0 - 1
Default:	0
Access	Configurable

This parameter determines if the cooling fan for the drive will always operate or only run when the temperature of the inverter exceeds the protective temperature limit.

0 = Always ON, cooling fan operates when power is applied to drive. Fan turns off when inverter voltage becomes low due to power off.
1 = Fan operates when temp above limit; fan begins to operate when power is ON and a operating command is ON. Fan turns off when operating command is turned off. Fan will continue to operate if the heat sink temperature exceeds a certain limit regardless of operating command. Use this setting for applications requiring frequent starts and stops.

H78 Operating method when cooling fan fails

Range:	0 - 1
Default:	0
Access	Configurable
See Also:	t32, t33

This parameter determines if what the drive will do if the cooling fan fails.

0 = Continuous operation when cooling fan malfunctions

Setting t32 or t33 = 18 (Cooling Fan Fault Alarm) will send an alarm signal to the output.

ATTENTION: If operation is continued after a fan trip occurs, an overheat trip may happen and protective functions may be activated. It may also reduce the life of main board components due to a rise in inverter internal temperatures.

1 = Operation stops when cooling fan malfunctions

When cooling fan fault occurs, FAn message is displayed on the LED and operation is stopped. If t32 and/or t33 is set to 17 (Fault Output), fault message is displayed.

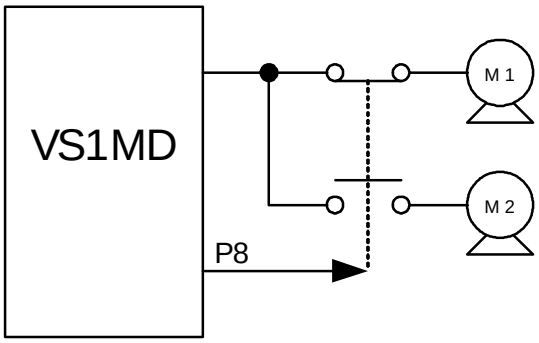
H81 - H90 **Second Motor Parameters**

Range:	See below
Default:	See below
Access	Configurable
See Also:	t1-t8

These parameters activate when a selected terminal is ON and one of the t1 thru t8 terminals is set for 12 (2nd Motor Select).

Param.	Description	Range	Factory Default	Adj. run
H81	Accel Time	0 ~ 60000 Sec	1.0	✓
H82	Decel Time	0 ~ 60000 Sec	5.0	✓
H83	Base Freq	30 ~ 400 Hz	60.0	-
H84	V/F Pattern	0 ~ 2	0	-
H85	FX Torque Boost	0 ~ 15 %	5	-
H86	RX Torque Boost	0 ~ 15 %	5	-
H87	Stall Level	30 ~ 150 %	150	-
H88	1 Min Overload Level	50 ~ 200 %	150	✓
H89	Continuous Overload Level	50 ~ 150 %	100	✓
H90	Motor Rated Current	0.1 ~ 50 Amps	26.3	-

Use these settings when an inverter operates two motors connected to two different types of loads. 2nd motor operation does not drive two motors at the same time. When first selected motor operation is stopped, select a terminal for the second motor and define H81 thru H90 to run the second motor.



Sets the V/F pattern for the second motor.

H91 **Parameter Read**

H92 **Parameter Write**

Range:	0-1
Default:	0
Access	Configurable

H91 Copies the parameters from the drive and saves them into a remote keypad.

H92 Copies the saved file in a remote keypad and writes it to the drive.

H93 **Parameter Initialize**

Range:	0 - 5
Default:	0
Access	Configurable

This parameter is used to initialize the drive settings back to their factory default values.

0 = No Action
1 = All parameters set to factory defaults

To reset individual groups only and not all parameters select one of the following:

2 = P Group Parameter Reset
3 = F Group Parameter Reset
4 = H Group Parameter Reset
5 = t Group Parameter Reset

Press the ENTER key after setting H93. H93 will be displayed again after initialization.

H94 **Password Register**

Range:	0-FFFF
Default:	0
Access	Tunable
See Also:	H95

This parameter is used to assign a password for the drive.

H95 **Parameter Lock**

Range:	0 -FFFF
Default:	0
Access	Tunable
See Also:	H94

This parameter is able to lock or unlock parameters by typing the password registered in H94.

CHAPTER 8
Customizing for Your Application

8.1 Frequency Mode

8.1.1 Keypad Frequency Setting 1

Group	Code	Parameter Name	Setting	Range	Initial	Unit
Drive group	P37	[Frequency Command]	-	0 to 400	0.00	Hz
	P40	[Frequency Setting Method]	1	1 to 7	1	

Step 1. Set **P40** [Frequency mode] to “1”.

Step 2. Set the desired frequency in **P37** and press the Prog/Ent (●) key to enter the value into memory.

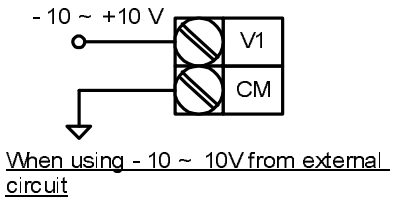
Step 3. The value can not be set above **P36** [Frequency Hiigh Limit].

Note: When remote keypad is connected, keypad keys on the body are deactivated.

8.1.2 Frequency Setting via –10 to +10[V] Input

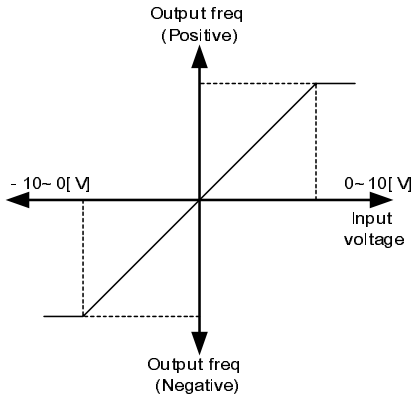
Group	Code	Parameter Name	Setting	Range	Initial	Unit
Drive group	P37	[Frequency Command]	-	0 to400	0.00	Hz
	P40	[Frequency Mode]	2	1 to 7	1	
t40 TO t44	t36	[NV Input Minimum Voltage]	-	0 to -10	0.0	V
	t37	[Frequency Corresponding to t36]	-	0 to 400	0.00	Hz
	t38	[NV Input Max Voltage]	-	0 to 10	10.00	V
	t39	[Frequency Corresponding to t38]	-	0 to 400	60.00	Hz
	t40 to t44	[V1 Input]				
Step 1. Set **P40** [Frequency Setting Method] to “2”. Step 2. The set frequency can be monitored in **D-0**[Frequency Command].						

Apply –10V to +10V signal between V1 and CM terminal.

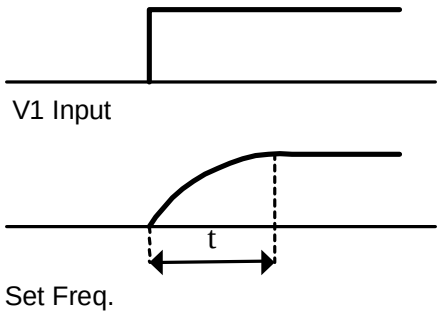


When using - 10 ~ 10V from external circuit

Output frequency corresponding to –10V to +10V input voltage to V1 terminal

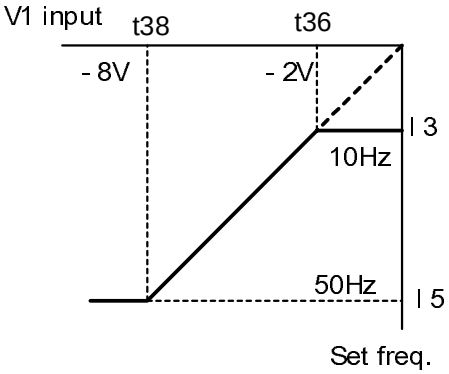


I1 (Filter time constant for NV input): Effective for eliminating noise in the frequency setting circuit. Increase the filter time constant if steady operation cannot be performed due to noise. A higher setting results in slower response (t gets longer).



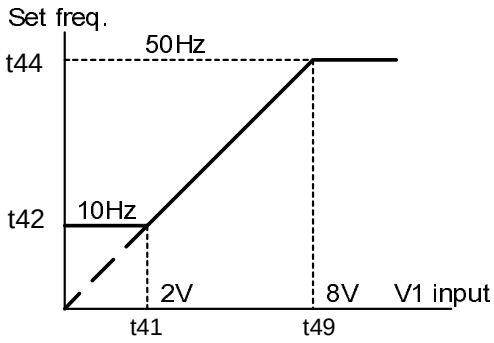
t36 to t39: Setting input range and corresponding frequency to -10V to 0V V1 input voltage

Ex) when minimum (-) input voltage is -2V with corresponding frequency 10Hz and Max voltage is –8V with run freq. 50Hz.



t40 to t44: Setting input range and corresponding frequency to 0 to +10V V1 input voltage

Ex) when minimum (+) input voltage is 2V with corresponding frequency 10Hz and Max voltage is 8V with run freq.



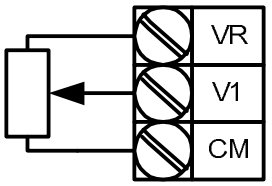
8.1.3 Frequency Setting via 0 to 10 [V] Input or Terminal Potentiometer

Group	Code	Parameter Name	Setting	Range	Initial	Unit
Drive group	P37	[Frequency Command]	-	0 to 400	0.00	Hz
	P40	[Frequency Setting Method]	3	1 to 7	1	
I/O group	t40	[Filter Time Constant for V1 Input]	10	0 to 9999	10	
	t41	[V1 Input Min Voltage]	-	0 to 10	0	V
	t42	[Frequency corresponding to I 7]	-	0 to 400	0.00	Hz
	t43	[V1 Input Max Voltage]	-	0 to 10	10	V
	t44	[Frequency Corresponding to I 9]	-	0 to 400	60.00	Hz

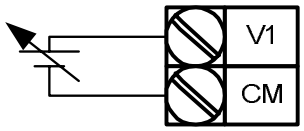
Step 1. Set **P40** [Frequency Setting Method] to “3”

Step 2. 0-10V can be directly applied from an external controller or a potentiometer connected on terminals VR, V1 and CM.

Wire the terminals as shown below.



Wiring of potentiometer



0 ~ 10V input via external controller

8.1.4 Frequency Setting via 0 to 20 [mA] Input

Group	Code	Parameter Name	Setting	Range	Initial	Unit
Drive group	P37	[Frequency Command]	-	0 to 400	0.00	Hz
	P40	[Frequency Setting Method]	4	1 to 7	1	
I/O group	t45	[Filter Time Constant for I Input]	10	0 to 9999	10	
	t46	[I Input Minimum Current]	-	0 to 20	4	mA
	t47	[Frequency Corresponding to I12]	-	0 to 400	0.00	Hz
	t48	[I input Max Current]	-	0 to 20	20	mA
	t49	[Frequency Corresponding to I14]	-	0 to 400	60.00	Hz

Step 1. Set **P40** [Frequency Setting Method] to “4”.

Step 2. Frequency is set via 0 to 20mA input between I and CM terminal.

8.1.5 Frequency Setting via -10 to +10[V] Voltage Input + 0 to 20[mA] Input

Group	Code	Parameter Name	Setting	Range	Initial	Unit
Drive group	P37	[Frequency Command]	-	0 to 400	0.00	Hz
	P40	[Frequency Setting Method]	5	1 to 7	1	

Step 1. Set **P40** [Frequency Setting Method] to “5”.

Step 2. Override function available using Main/Auxiliary speed adjustment

Step 3. Related code: t36, t39, t40, t44, t45, t49

Override function allows more precise control and a faster response by combining Main and Auxiliary speed input. Fast response can be achieved via Main speed and precise control can be accomplished by Aux. speed if the accuracy of Main/Aux speed is set differently.

Follow the settings shown in the table below when Main speed is given via 0 to 20mA with Aux. speed via V1 terminal (–10 to 10V).

When override function is used, select the Main/Aux. speed according to loads used.

Group	Code	Parameter Name	Setting	Unit
I/O group	t36	[NV Input Min Voltage]	0	V
	t37	[Frequency Corresponding to t36]	0.00	Hz
	t38	[NV Input Max Voltage]	10.00	V
	t39	[Frequency Corresponding to t38]	5.00	Hz
	t41	[V1 Input Min Voltage]	0	V
	t42	[Frequency Corresponding to t41]	0.00	Hz
	t43	[V1 Input Max Voltage]	10	V
	t44	[Frequency Corresponding to t43]	5.00	Hz
	t46	[I Input Minimum Current]	4	mA
	t47	[Frequency Corresponding to t46]	0.00	Hz
	t48	[I Input Max Current]	20	mA
	t49	[Frequency Corresponding to t48]	60.00	Hz

After the above parameters are set, if 5V is applied to V1 with 12mA given to terminal I, output frequency would be 32.5Hz. If –5V is applied to V1 terminal with 12mA given to terminal I, output frequency would be 27.5Hz.

8.1.6 Frequency Setting via 0 to 10[V] + 0 to 20[mA] Input

Group	Code	Parameter Name	Setting	Range	Initial	Unit
Drive group	P37	[Frequency Command]	-	0 to 400	0.00	Hz
	P40	[Frequency Mode]	6	1 to 7	1	

Step 1. Set **P40** [Frequency Setting Method] to “6”.

Step 2. Related code: t40 to t44, t45 to t49

Step 3. Refer to Frequency setting via -10 to +10V voltage input + 0 to 20mA input.

8.1.7 Frequency Setting via RS 485 Communication

Group	Code	Parameter Name	Setting	Range	Initial	Unit
Drive group	P37	[Frequency Command]	-	0 to400	0.00	Hz
	P40	[Frequency Setting Method]	7	1 to 7	1	
Set **P40** [Frequency Setting Method] to “7”. Related code: t59 - t61 Refer to Appendix D. RS485 communication.						

8.1.8 Operating Command via RS485 Communication

Group	Code	Parameter Name	Setting	Range	Initial	Unit
Drive group	P38	[Drive Mode]	3	0 to 3	1	
I/O group	t59	[Communication Protocol Selection]	-	0 to 1	0	
	t60	[Inverter Number]	-	1 to 250	1	
	t61	[Baud Rate]	-	0 to 4	3	
Step 1. Set **P38** [Drive Mode] to “3”. Step 2. Set t59, t60 and t61 correctly. Step 3. Drive operation is performed via RS485 communication.						

8.1.9 Rotating Direction Selection via –10 to +10[V] Input of V1 Terminal

Group	Code	Parameter Name	Setting	Range	Initial	Unit
Drive group	P40	[Frequency Setting]	2	1 to 7	1	
	P38	[Drive Mode]	-	0 to 3	1	
Step 1. Set **P40** to 2. Step 2. Inverter is operating as the table below regardless of Drive mode setting.						

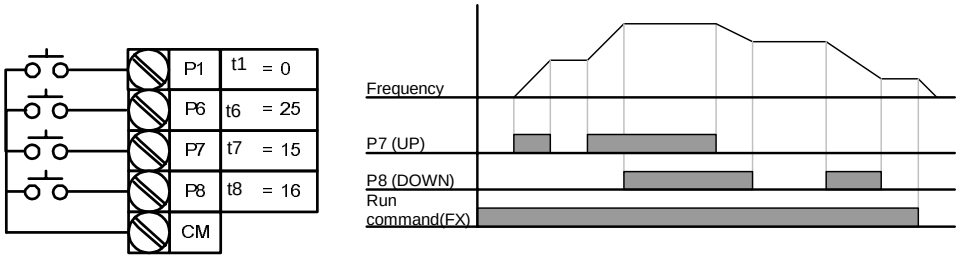
	FWD RUN Command	REV RUN Command
0 to +10 [V]	FWD RUN	REV RUN
-10 to 0 [V]	REV RUN	FWD RUN

Motor runs in Forward direction when input voltage to V1-CM is between 0 and 10[V] and FWD RUN command is active. When input voltage polarity is reversed to –10 to 0[V] during FWD RUN, motor decelerates to stop and runs in reverse direction.

Motor runs in Reverse direction when input voltage to V1-CM is between 0 and 10[V] and REV RUN command is active. When input voltage polarity is reversed to –10 to 0[V], motor decelerates to stop and runs in forward direction.

8.2 UP-Down

Group	Display	Parameter Name	Setting	Range	Default	Unit
I/O group	t1	[Multi-function Input Terminal P1 Selection]	0	0 to 25	0	
	to	to				
	t7	[Multi-function Input Terminal P7 Selection]	15		6	
	t8	[Multi-function Input Terminal P8 Selection]	16		7	
Select terminals for Up-Down operation from P1-P8. If P7 and P8 are selected, set t7 and t8 to 15 [Frequency Up command] and 16 [Frequency Down command], respectively. If P6 is selected, set t6 to t8 [Up/Down Save Frequency Initialization].						

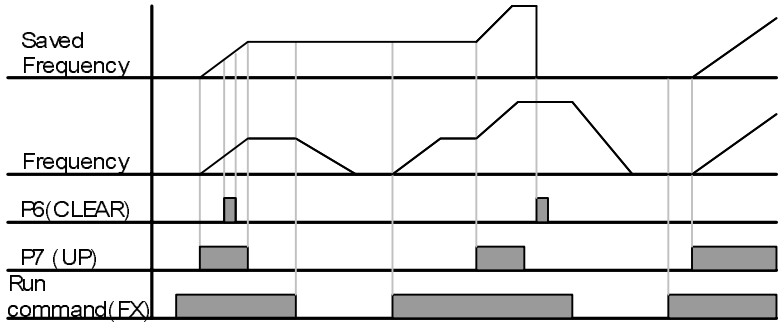


Up/down Save function: If F63, ‘Save up/down frequency’, is set to 1, the frequency before the inverter was stopped or decelerated is saved in F64.

F63	Save up/down frequency select	0	Remove ‘save up/down frequency’
		1	Set ‘save up/down frequency’
F64	Save up/down frequency	Up/down frequency saved	

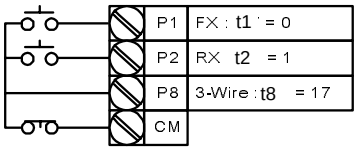
The Up/down frequency can be initialized by setting the multi-function input terminal as ‘Up/Down Save Frequency Initialization’.

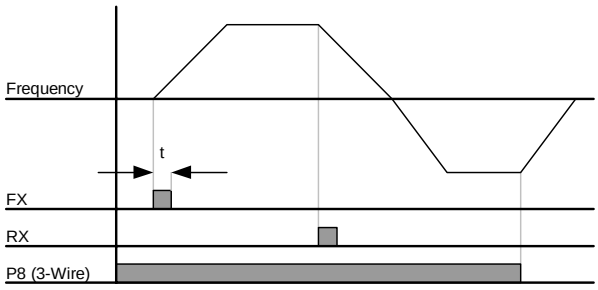
If ‘Up/Down Save Frequency Initialization’ signal is input while the multi-function input ‘Up’ or ‘Down’ function is applied, this signal is ignored.



8.3 3-Wire

Group	Display	Parameter Name	Setting	Range	Default	Unit
I/O group	t1	[Multi-function Input Terminal P1 Selection]	0	0 to 24	0	
	to	to				
	t8	[Multi-function Input Terminal P8 Selection]	17		7	
Select the terminal from P1-P8 for use as 3-Wire operation. If P8 is selected, set I24 to “17” [3-Wire operation].						





Input signal is saved in 3-Wire operation. Therefore, inverter can be operated by Push-button switch.

The bandwidth of pulse (t) should not be less than 50msec.

8.4 PID Control

Group	Display	Parameter Name	Setting	Range	Default	Unit
Function group 2	H40	[Control Mode Selection]	2	0 to 3	0	-
	H50	[PID Feedback Selection]	-	0 to 1	0	-
	H51	[P Gain for PID Controller]	-	0 to 999.9	300.0	%
	H52	[I Gain for PID Controller]	-	0.1 to 32.0	1.0	sec
	H53	[D Gain for PID Controller]	-	0.0 to 30.0	0	sec
	H54	[F Gain for PID Controller]		0 to 999.9	0	%
	H55	[PID Output Frequency High Limit]	-	0.1 to 400	60.0	Hz
	H56	[PID Output Frequency Low Limit]	-	0.1 to 400	0.50	Hz
I/O group	t1 to t8	[Multi-function Input Terminal P1-P8 Definition]	21	0 to 25	-	-
Drive group	d1	[Motor RPM]				
Set H40 to “2” [PID Feedback control]. Output frequency of the inverter is controlled by PID control for use as constant control of flow, pressure or temperature.						

H50: Select the feedback type of PID controller.

H50	[PID Feedback Selection]	0	Terminal I input (0 to 20[mA])
		1	Terminal V1 input (0 to 10[V])

H51: Set the percentage of output to error. If P Gain is set to 50%, 50% of the error value will be output. Higher value can reach the target control value faster but it may cause oscillation.

H52: Set the time to output the accumulated error value. Set the time required to output 100% when the error value is 100%. If H52 [Integral time for PID controller (I gain)] is set to 1 sec and the error becomes 100%, 100% will be output in 1 sec. Adjusting the value may reduce the nominal error. If the value is reduced, response will be faster but setting too low may lead to controller oscillation.

H53: Set the output value to the variation of the error. The error is detected by 0.01 sec in SV-iG5A. If differential time is set to 0.01 sec and the percentage variation of error per 1 sec is 100%, 1% per 10msec is output.

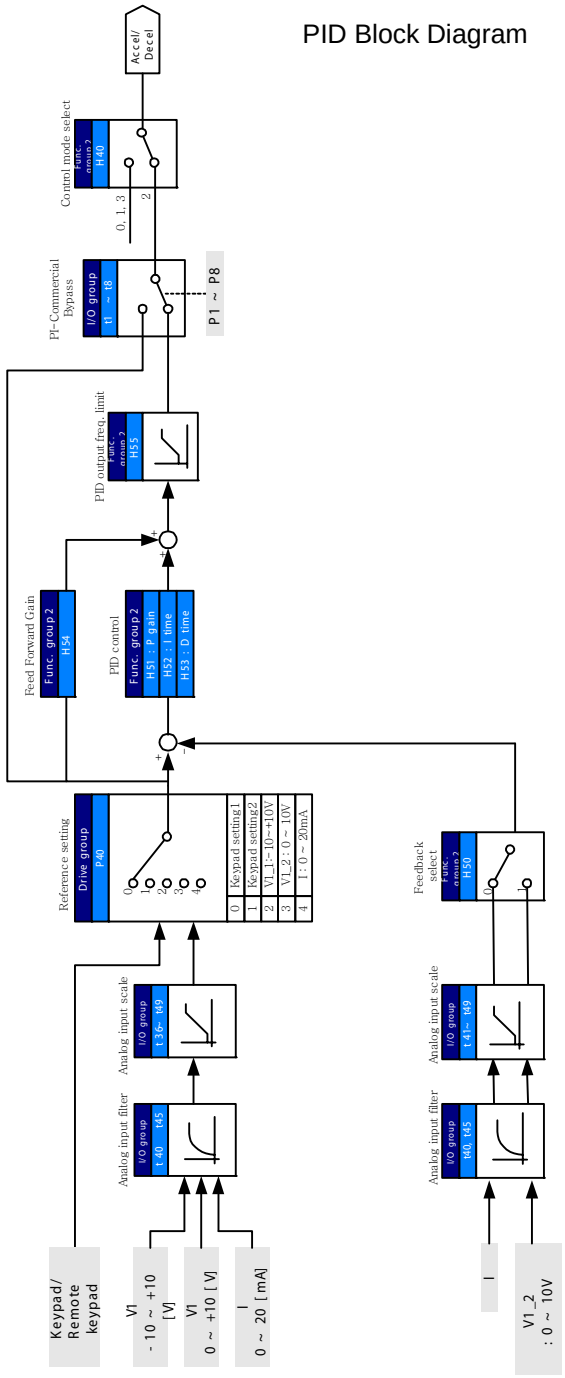
H54: PID Feed Forward Gain. Set the gain to add the target value to the PID controller output.

H55, H56: Limits the output of the PID controller.

I17 to I24: To go from PID to normal operation, set one of P1-P8 terminal to 21 and turn ON.

d1: Calculates the feedback from H50 into Motor frequency and displays it.

PID Block Diagram



8.5 Auto-tuning

Group	Display	Parameter Name	Setting	Range	Default	Unit
H-Function group 2	H41	[Auto Tuning]	1	0 to 1	0	-
	H42	[Stator Resistance (Rs)]	-	0 to 28	-	W
	H44	[Leakage Inductance (Lσ)]	-	0 to 300.00	-	mH
Motor parameters will be automatically measured. The measured motor parameters in H41 can be used in Auto Torque Boost and Sensorless Vector Control.						

ATTENTION: Auto tuning should only be executed after motor has stopped. Motor shaft must not run by the load during H41[Auto tuning].

H41: When H41 is set to 1 and press the Enter (ò) key, Auto tuning is activated and “TUn” will appear on the LED keypad. When finished, “H41” will be displayed.

H42, H44: The values of motor stator resistance and leakage inductance detected in H41 are displayed, respectively. When Auto tuning is skipped or H93 – [Parameter initialize] is done, the default value corresponding to motor type (H30) will be displayed.

Press the STOP/RST key on the keypad or turn on the EST terminal to stop the Auto Tuning.

If Auto tuning of H42 and H44 is interrupted, the default value will be set. If H42 and H44 are finished and auto-tuning of leakage inductance is interrupted, the measured value of H42 and H44 are used and the default of leakage inductance is set.

See page for motor parameter default values.

ATTENTION: Be sure accurate values are entered for stator resistance and leakage inductance. Otherwise, the performance of Sensorless vector control and Auto torque boost could be compromised.

8.6 Sensorless Vector Control

Group	Display	Parameter Name	Setting	Range	Default	Unit
H - Function group 2	H40	[Control Mode Selection]	3	0 to 3	0	-
	P30	[Motor Type Selection]	-	0.2 to 7.5	-	kW
	H32	[Rated Slip Frequency]	-	0 to 10	-	Hz
	P32	[Motor Rated Current]	-	0.5 to 50	-	A
	H34	[Motor No Load Current]	-	0.1 to 20	-	A
	H42	[Stator Resistance (Rs)]	-	0 to 14	-	W
	H44	[Leakage Inductance (Lσ)]	-	0 to 300.00	-	mH
Function group 1	F14	[Time for Energizing a Motor]	-	0.0 to 60.0	0.1	sec
If H40[Control mode Selection] is set to “3”, Sensorless vector control will become active.						

ATTENTION: Motor parameters should be measured for optimal performance. It is highly recommended H41 [Auto tuning] be done prior to operating via Sensorless vector control.

Ensure that the following parameters are entered correctly for optimal performance in Sensorless vector control.

P30: Select motor type connected to inverter output.

H32: Enter rated slip frequency based on motor nameplate RPM and rated frequency (See 10-6).

P32: Enter motor nameplate rated current.

H34: After removing the load, set H40[Control mode Selection] to “0” [V/F control] and run the motor at 60Hz. Enter the current displayed in Cur-[Output current] as motor no load current. If it is difficult to remove the load from the motor shaft, enter a value equal to 40 to 50% of H33[Motor rated current] or the factory default.

H42, H44: Enter the value of the parameter measured during H41[Auto tuning] or the factory default.

F14: This parameter accelerates the motor after pre-exciting the motor for the set time. The amount of the pre-exciting current is set in H34[Motor No Load Current].

Directly enter the motor nameplate value except motor rating when 0.2kW is used.

Factory default by motor ratings

Input voltage	Motor rating [kW]	Current rating [A]	No-load current [A]	Rated slip freq [Hz]	Stator resistance [Ω]	Leakage inductance [mH]
200	0.2	1.1	0.6	2.33	14.0	122.00
	0.4	1.8	1.2	3.00	6.70	61.00
	0.75	3.5	2.1	2.33	2.46	28.14
	1.5	6.5	3.5	2.33	1.13	14.75
	2.2	8.8	4.4	2.00	0.869	11.31
	3.7	12.9	4.9	2.33	0.500	5.41
	5.5	19.7	6.6	2.33	0.314	3.60
	7.5	26.3	9.0	2.33	0.169	2.89
400	0.2	0.7	0.4	2.33	28.00	300.00
	0.4	1.1	0.7	3.0	14.0	177.86
	0.75	2.0	1.3	2.33	7.38	88.44
	1.5	3.7	2.1	2.33	3.39	44.31
	2.2	5.1	2.6	2.00	2.607	34.21
	3.7	6.5	3.3	2.33	1.500	16.23
	5.5	9.9	3.9	2.33	0.940	10.74
	7.5	15.2	5.7	2.33	0.520	8.80

8.7 Speed Search

Group	Display	Parameter Name	Setting	Range	Default	Unit
Function group 2	H22	[Speed Search Selection]	-	0 to 15	0	
	H23	[Current Level]	-	80 to 200	100	%
	H24	[Speed Search P Gain]	-	0 to 9999	100	
	H25	[Speed Search I Gain]	-		200	
I/O group	t32	[Multi-function Output Terminal Selection]	15	0 to 18	12	
	t33	[Multi-function Relay Selection]	15		17	
This is used to prevent possible faults from occurring if the inverter outputs the voltage during operation after the load is removed. The inverter estimates the motor rpm based on output current. Therefore, detecting exact speed is difficult.						

The following table shows 4 types of Speed search selections.

		Speed Search During H20[Power ON Start]	Speed Search During Instant Power Failure Restart	Speed Search During H21[Restart After Fault Reset]	Speed Search During Acceleration
		Bit 3	Bit 2	Bit 1	Bit 0
H22	0	-	-	-	-
	1	-	-	-	✓
	2	-	-	✓	-
	3	-	-	✓	✓
	4	-	✓	-	-
	5	-	✓	-	✓
	6	-	✓	✓	-
	7	-	✓	✓	✓
	8	✓	-	-	-
	9	✓	-	-	✓
	10	✓	-	✓	-
	11	✓	-	✓	✓
	12	✓	✓	-	-
	13	✓	✓	-	✓
	14	✓	✓	✓	-
	15	✓	✓	✓	✓

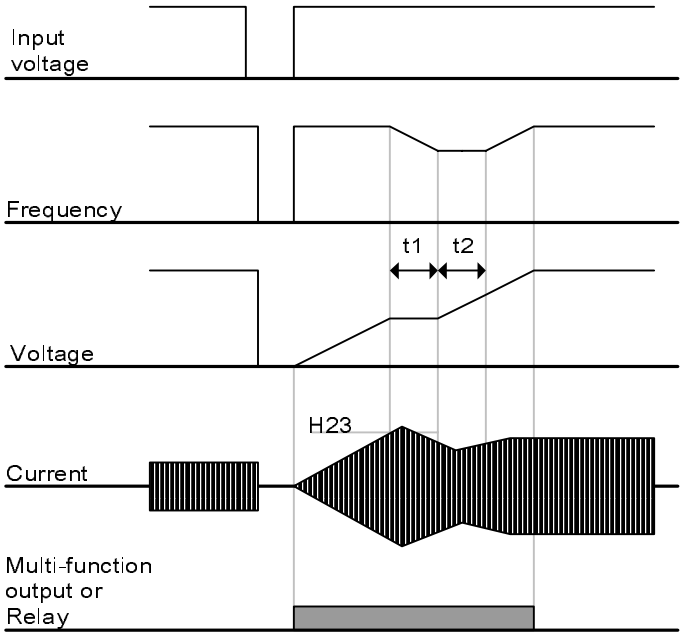
H23: Limits current during Speed search. Set as a percentage of H33.

H24, H25: Speed search is activated via PI control. Adjust P gain and I gain corresponding to the load characteristics.

t32, t33: Signal of active Speed search is given to external sequence via Multi-function output terminal (MO) and Multi-function relay output (3ABC).

Example

Speed search during Instant Power Failure restart



- When the input power is cut off due to instant power failure, the inverter outputs Low voltage trip (LV) to hold the output.
- When the power is restored, the inverter outputs the frequency before the low voltage trip and the voltage is increased due to PI control.
- t1: If current is increasing over the preset level in H23, the rise in voltage will stop and the frequency is decreased.
- t2: If the opposite of t1 occurs, the increase in voltage starts again and the decrease in frequency stops.
- When the frequency and voltage are restored back to the nominal level, acceleration will continue at the frequency before trip.

Speed search operation is suitable for loads with high inertia. Stop the motor and restart when friction in load is high.

VS1MD keeps normal operation when instant power failure occurs and power is restored in 15msec for the use of its inverter rating.

Inverter DC link voltage can vary depending on output load quantity. Therefore, Low Voltage trip may occur when instant power failure is maintained over 15msec or output is higher than its rating.

Instant power failure specification is applied when input voltage to Inverter is 200 to 230V AC for 200V class, or 380 to 480V AC for 400V class.

8.8 Self-Diagnostic Function

8.8.1 How to Use Self-Diagnostic Function

Group	Display	Parameter Name	Setting	Range	Default	Unit
Function group 2	H60	Self-Diagnostic Selection	-	0 to 3	0	-
I/O group	t1	Multi-function Input Terminal P1 Selection	-	0 to 25	0	-
	to	to				
	t8	Multi-function Input Terminal P8 Selection	20		7	-
Select Self-Diagnostic function in H60, Function group 2. Define one terminal among P1toP8 terminals for this function. To define P8 for this function, set t8 to “20”.						
		ATTENTION: Do not touch the inverter with hands or other objects while performing this function because current is flowing to the inverter output.				

Perform Self-diagnostic function after input/output wiring of the inverter is finished.

This function allows the user to safely check for the IGBT fault, output phase open and short, and Ground fault without disconnecting the inverter wiring.

There are 4 options:

H60[1]	Self-Diagnostic function	0	Self-Diagnostic disabled
		1	IGBT fault and Ground fault[2]
		2	Output phase short & open circuit and Ground fault
		3	Ground fault (IGBT fault, Output phase short and open circuit)

[1]Selecting the higher number performs all functions within lower numbers.

[2]Ground fault of U phase in 2.2KW to 4.0KW inverters and ground fault of V phase in other rating inverters may not be detected when selecting “1”. Select 3 to make sure to detect all phase of U, V, W

Once H60 is set to a specific value from 1 to 3 and the terminal defined for this function among P1 to P8 terminals is turned ON, the corresponding function is conducted, displaying “dIAG”

To stop this function, press STOP/RESET key on the keypad, turn the defined terminal OFF or turn the EST terminal ON.

The following table shows the fault type while this function is active.

No.	Display	Fault type	Diagnosis
1	UPHF	Switch above IGBT's U phase fault	Contact sales representatives.
2	UPLF	Switch below IGBT's U phase fault	
3	vPHF	Switch above IGBT's V phase fault	
4	vPLF	Switch below IGBT's V phase fault	
5	WPHF	Switch above IGBT's W phase fault	
6	WPLF	Switch below IGBT's U phase fault	
7	UWSF	Output short between U and W	Check for a short in inverter output terminal, motor connection terminal or the proper motor connection.
8	vUSF	Output short between U and V	
9	WvSF	Output short between V and W	
10	UPGF	Ground fault at U phase	Check for ground fault occurring at inverter output cable or motor or motor insulation damage.
11	vPGF	Ground fault at V phase	
12	WPGF	Ground fault at W phase	
13	UPOF	Output open at U phase	Check for proper connection of the motor to the inverter output or proper motor connection.
14	vPOF	Output open at V phase	
15	WPOF	Output open at W phase	

8.9 Parameter Read/Write

Group	Display	Parameter Name	Setting	Range	Default	Unit
Function group 2	H91	[Parameter Read]	1	0 to 1	0	
	H92	[Parameter Write]	1	0 to 1	0	
Used to read/write Inverter Parameters using remote keypad.						

ATTENTION: Take caution when Parameter write (H92) is executed. By doing this, parameters in inverter are cleared and parameters in remote keypad are copied to inverter.

8.9.1 Parameter Read

Step 1. Move to H91 code.

Step 2. Press Enter (●) key once. 0 will be displayed.

Step 3. Press Up (▲) key once. Rd will be displayed.

Step 4. Press Enter (●) key twice. Rd will be displayed

Step 5. H91 is displayed when Parameter read is finished.

8.9.2 Parameter Write

Step 1. Move to H92 code. H92 will be displayed.

Step 2. Press Enter (●) key once. 0 will be displayed.

Step 3. Press Up (▲) key once. Wr will be displayed.

Step 4. Press Enter (●) key twice. Wr will be displayed.

Step 5. H91 is displayed when Parameter read is finished.

8.10 Parameter Initialization / Lock

8.10.1 Parameter Initialization

Group	Display	Parameter Name	Range		Default
Function group 2	H93	[Parameter Initialization]	0	-	0
			1	Initialize All Groups	
			2	Initialize Drive Group	
			3	Initialize F 1 Group	
			4	Initialize F 2 Group	
			5	Initialize I/O group	
Select the group to be initialized and perform it in H93 code.					

Press Enter (●) key after setting in H93. H93 will be displayed again after initialization is complete.

8.10.2 Password Registration

Group	Display	Parameter Name	Setting	Range	Default	Unit
Function group 2	H94	[Password Registration]	-	0 to FFFF	0	
	H95	[Parameter Lock]	-	0 to FFFF	0	
Register password for Parameter lock (H95). Password should be Hex decimal. (0 to 9, A, B, C, D, E, F)						
	ATTENTION: <u>Do not forget the registered password.</u> It is needed to unlock parameters.					

Factory default password is 0. Enter any new password except 0.

8.10.2.1 Registering the password for the first time.

Step 1. Move to H94 code. H94 will be displayed.

Step 2. Press Enter (●) key twice. 0 will be displayed.

Step 3. Register password. (Ex: 123) 123 will be displayed.

Step 4. 123 will blink when Enter (●) key is pressed. 123 will be displayed.

Step 5. Press Enter (●) key. H94 will be displayed after the new password has been registered.

8.10.2.2 Changing password. (Current PW: 123 -> New PW: 456)

Step 1. Move to H94 code. H94 will be displayed.

Step 2. Press Enter (●) key. 0 will be displayed.

Step 3. Enter any number (e.g.: 122). 122 will be displayed.

Step 4. Press the Enter (●) key. 0 is displayed because wrong value was entered. Password cannot be changed in this status. 0 will be displayed.

Step 5. Enter the right password. 123 will be displayed.

Step 6. Press Enter (●) key. 123 will be displayed.

Step 7. Enter the new password. (e.g. 456). 456 will be displayed.

Step 8. Press the Enter (●) key. Then “456” will blink. 456 will be displayed.

Step 9. Press Enter (●) key. H94 will be displayed.

8.10.3 Parameter Lock

Group	Display	Parameter Name	Setting	Range	Default	Unit
Function group 2	H95	[Parameter Lock]	-	0 to FFFF	0	
	H94	[Password Registration]	-	0 to FFFF	0	
This parameter is used to lock the user-set parameters using the password.						

8.10.3.1 Locking the user-set parameters.

Step 1. Move to H95 code. H95 will be displayed.

Step 2. Press Enter (●) key. UL will be displayed.

Step 3. Parameter value can be changed in UL (Unlock) status. UL will be displayed.

Step 4. Press Enter (●) key. 0 will be displayed.

Step 5. Enter the password created in H94 (e.g.: 123). 123 will be displayed.

Step 6. Press Enter (●) key. L will be displayed.

Step 7. Parameter value cannot be changed in L (Lock) status. L will be displayed.

Step 8. Press Enter (●) key. H95 will be displayed.

8.10.3.2 Unlocking the user-set parameter.

Step 1. Move to H95 code. H95 will be displayed.

Step 2. Press Enter (●) key. L will be displayed.

Step 3. Parameter value cannot be changed in L(Lock) status. L will be displayed.

Step 4. Press Enter (●) key. 0 will be displayed.

Step 5. Enter the password created in H94 (e.g.: 123). 123 will be displayed.

Step 6. Press Enter (●) key. UL will be displayed.

Step 7. Parameter value can be changed in UL (Unlock) status. While UL is displayed, press Enter (●) key. H95 will be displayed.

8.11 Multi-function Output Terminal (MO) and Relay (3AC)

Group	Code	Parameter	Setting range				Initial
I/O group	t32	[Multi-function output terminal Selection]	0	FDT-1			12
			1	FDT-2			
	t33	[Multi-function relay Selection]	2	FDT-3			17
			3	FDT-4			
			4	FDT-5			
			5	Overload [OLt]			
			6	Inverter Overload [IOLt]			
			7	Motor stall [STALL]			
			8	Over voltage trip [OV]			
			9	Low voltage trip [LV]			
			10	Inverter overheat [OH]			
			11	Command loss			
			12	During run			
			13	During stop			
			14	During constant run			
			15	During speed searching			
			16	Wait time for run signal input			
			17	Fault output			
			18	Cooling fan trip alarm			
	t34	[Fault relay output]		When setting H26 [Number of auto restart tries]	When trip other than low voltage trip occurs	When low voltage trip occurs	
				Bit 2	Bit 1	Bit 0	
			0	-	-	-	2
			1	-	-	✓	
			2	-	✓	-	
			3	-	✓	✓	
			4	✓	-	-	
			5	✓	-	✓	
			6	✓	✓	-	
			7	✓	✓	✓	
Select the desired item to be output via MO terminal and relay (30AC).							

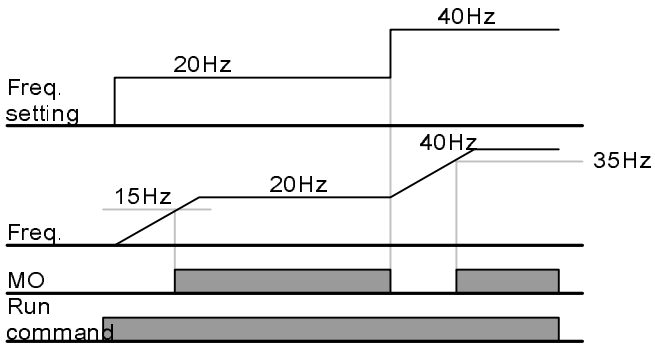
t34: When 17 [Fault display] is selected in t32 and t33, Multi-function output terminal and relay will be activated with the value in t34.

8.11.1 FDT-1

Check whether the output frequency matches the user-setting frequency.

Active condition: Absolute value (preset frequency - output frequency) <= Frequency Detection Bandwidth/2

Group	Display	Parameter Name	Setting	Range	Default	Unit
I/O group	t31	[Detected Frequency Bandwidth]	-	0 to 400	10.00	Hz
Cannot be set above Max frequency (P36).						



When setting t31 to 10.0

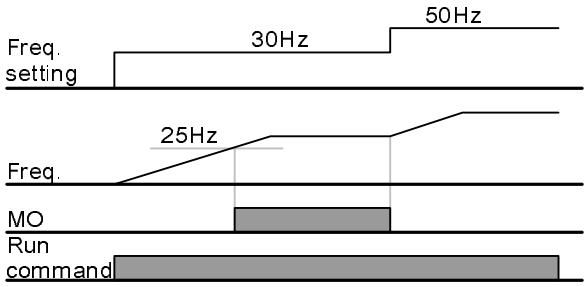
8.11.2 FDT-2

Activated when the preset frequency matches frequency detection level (t52) and FDT-1 condition is met.

Active condition: (Preset frequency = FDT level) & FDT-1

Group	Display	Parameter Name	Setting	Range	Default	Unit
I/O group	t30	[Detected Frequency level]	-	0 to 400	30.00	Hz
	t31	[Detected Frequency Bandwidth]	-		10.00	
Cannot be set above Max frequency (P36).						

When setting t30 and t31 to 30.0 Hz and 10.0 Hz, respectively



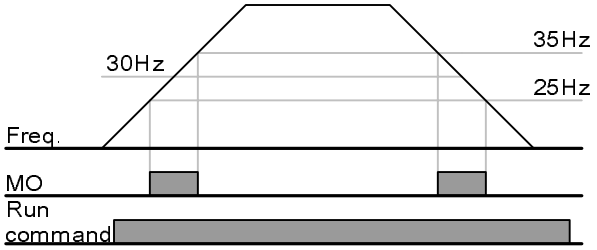
8.11.3 FDT-3

Activated when run frequency meets the following condition.

Active condition: Absolute value (FDT level - run frequency) <= FDT Bandwidth/2

Group	Display	Parameter Name	Setting	Range	Default	Unit
I/O group	t30	[Detected Frequency level]	-	0 to 400	30.00	Hz
	t31	[Detected Frequency Bandwidth]	-		10.00	
Cannot be set above Max frequency (P36).						

When setting t30 and t31 to 30.0Hz and 10.0 Hz, respectively



8.11.4 FDT-4

Activated when run frequency meets the following condition.

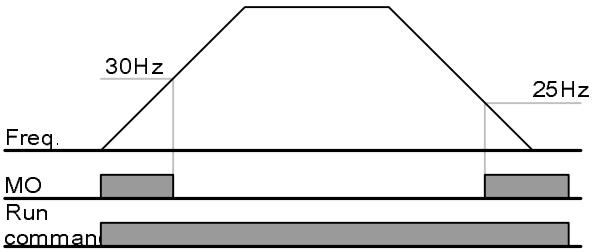
Active condition:

Accel time: Run Frequency >= FDT Level

Decel time: Run Frequency > (FDT Level – FDT Bandwidth/2)

Group	Display	Parameter Name	Setting	Range	Default	Unit
I/O group	t30	[Detected Frequency level]	-	0 to 400	30.00	Hz
	t31	[Detected Frequency Bandwidth]	-		10.00	
Cannot be set above Max frequency (P36).						

When setting t30 and t31 to 30.0Hz and 10.0 Hz, respectively



8.11.5 FDT-5

Activated as B contact contrast to FDT-4.

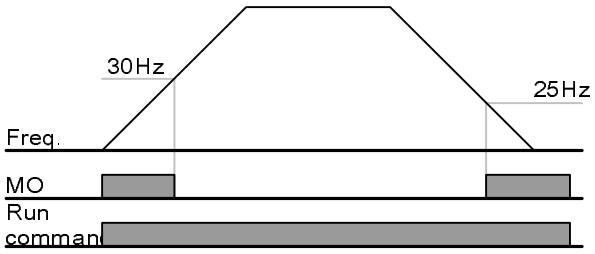
Active condition:

Accel time: Run Frequency >= FDT Level

Decel time: Run Frequency > (FDT Level – FDT Bandwidth/2)

Group	Display	Parameter Name	Setting	Range	Default	Unit
I/O group	t30	[Detected Frequency level]	-	0 to 400	30.00	Hz
	t31	[Detected Frequency Bandwidth]	-		10.00	
Cannot be set above Max frequency (P36).						

When setting t30 and t31 to 30.0Hz and 10.0 Hz, respectively



8.11.6 Over Voltage Trip (Ovt)

Activated when over voltage trip occurs due to DC link voltage exceeded 460Vdc for 230V class and 820Vdc for 460V class.

8.11.7 Low Voltage Trip (Lvt)

Activated when low voltage trip occurs due to DC link voltage under 180Vdc for 200V class and 360Vdc for 400V class.

8.11.8 Inverter Heatsink Overheat (OHt)

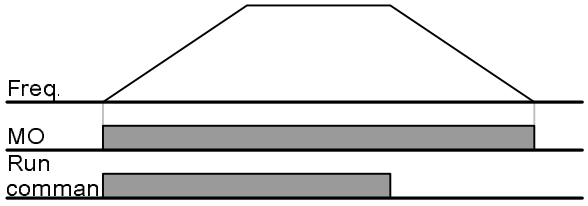
Activated when the heatsink is overheated.

8.11.9 Command Loss

Activated when Analog (V1,I) and RS485 communication commands are lost.

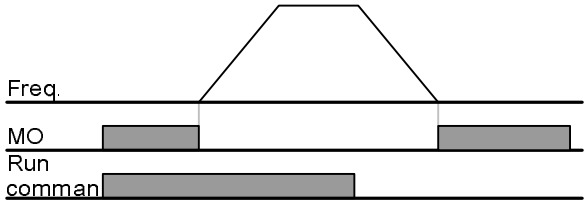
8.11.10 During Operation

Activated when run command is input and inverter outputs its voltage.



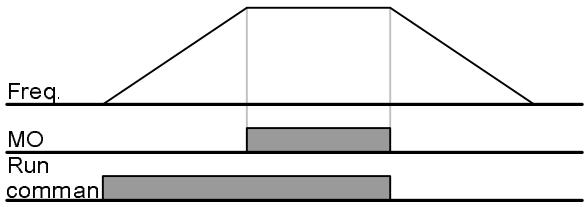
8.11.11 During Stop

Activated during stop without active command.



8.11.12 During Constant Run

Activated during constant speed operation.



8.11.13 Wait Time for Run Signal Input

This function becomes active during normal operation and that the inverter waits for active run command from external sequence.

8.11.14 Fault Output

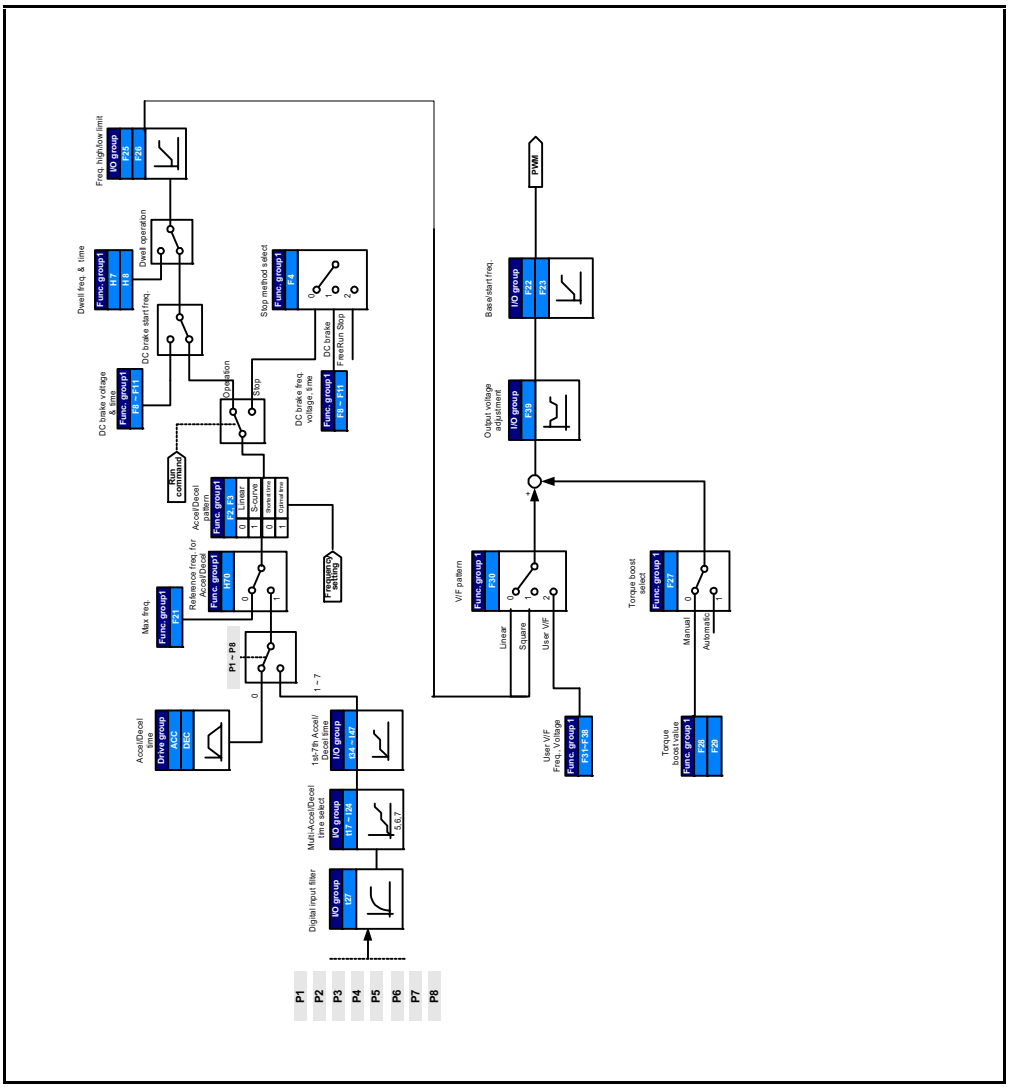
The parameter set in t34 is activated.

For example, if setting t33, t34 to 17 and 2, respectively, Multi-function output relay will become active when trip other than “Low voltage trip” occurred.

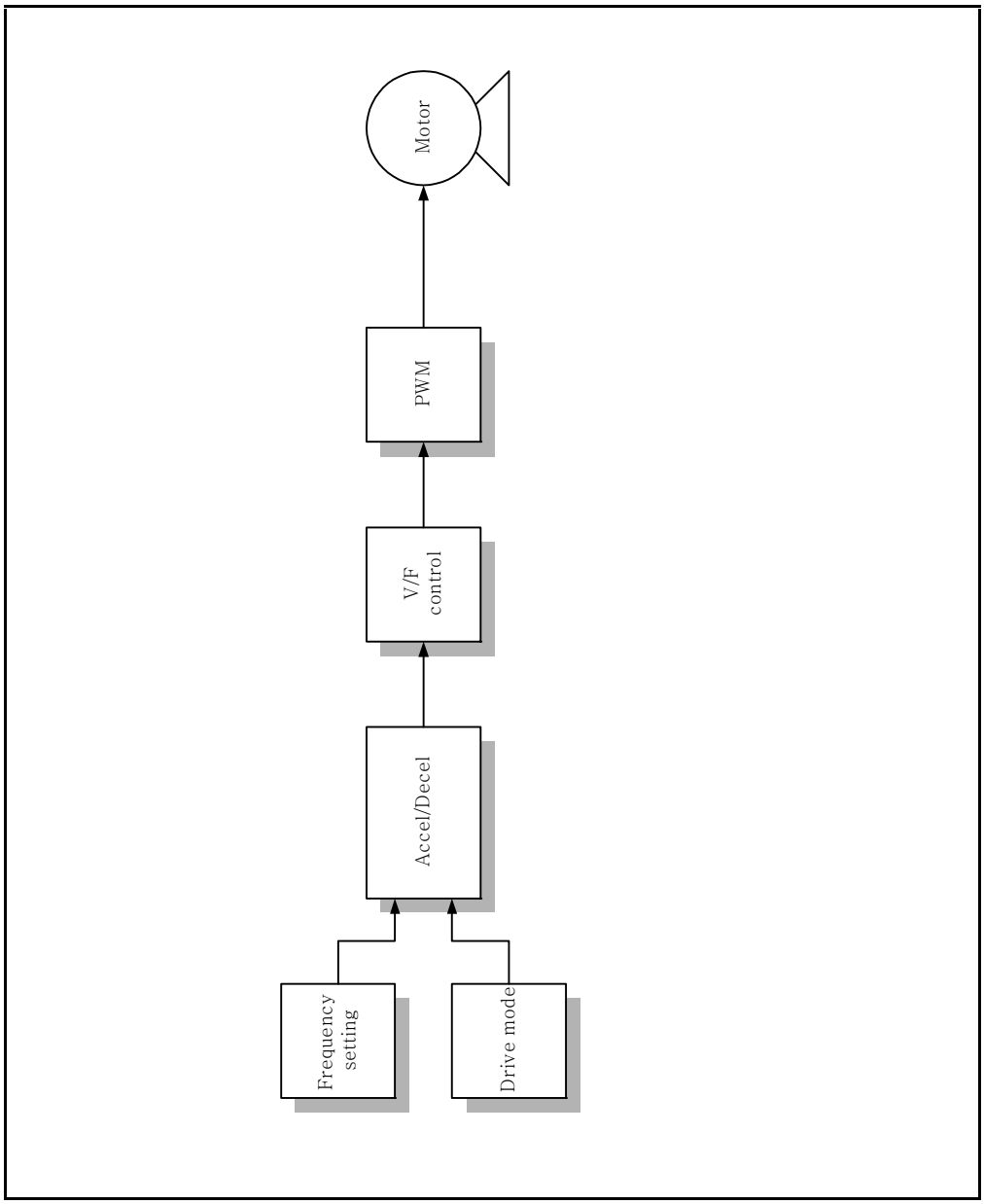
8.11.15 Cooling Fan Trip Alarm

Used to output alarm signal when H78 is set to ”0”(constant operation at cooling fan trip).

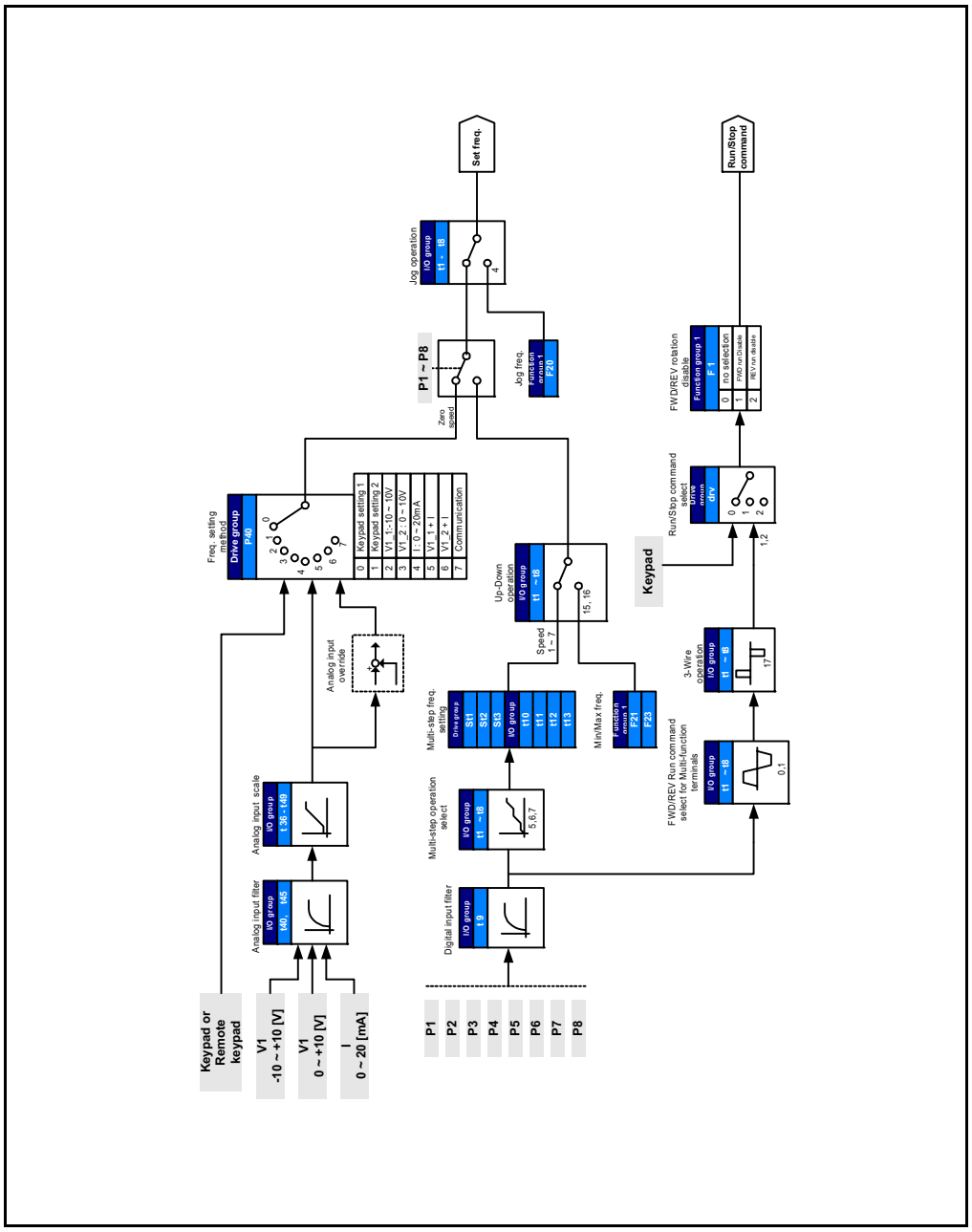
8.12 Accel/Decel setting and V/F Control



8.13 Control Block Diagram



8.14 Frequency and Drive Mode Setting



CHAPTER 9
Troubleshooting

ATTENTION: This drive contains high voltage capacitors that take time to discharge after removal of mains supply. Before working on the drive, ensure isolation of mains supply from line inputs. Wait ten (10) minutes for capacitors to discharge to safe voltage levels. Failure to observe this precaution could result in severe bodily injury or loss of life.

ATTENTION: Only qualified electical personnel familiar with the construction and operation of this equipment and the hazards involved should install, adjust, operate, or service this equipment. Read and understand this manual and other applicable manuals in their entirety before proceeding. Failure to observe this precaution could result in severe bodily injury or loss of life.

The VS1MD constantly monitors its status and provides the following ways to determine the status of the drive and to troubleshoot problems that may occur:

- LEDS on the drive
- Fault Codes displayed on seven segment display
- Drive monitor and status parameters
- Entries in the fault queue

9.1 Verifying that DC Bus Capacitors are Discharged Before Servicing the Drive

ATTENTION: DC Bus capacitors retain hazardous voltages after input power has been disconnected. After disconnectiong input power, wait ten (10) minutes for the DC Bus capacitors to discharge and then check the voltage with a voltmeter to ensure the DC bus capacitors are discharged before touching any internal components. Failure to observe this precaution could result in severe bodily injury or loss of life.

The drive's DC bus capacitors retain hazardous voltages after input power has been disconnected. Perform the following steps before touching any internal components:

Step 1. Turn off and lock out input power. Wait 10 minutes after drive's 7-segment display goes blank.

Step 2. Open the drive's cover.

Step 3. Verify that there is no voltage at the drive's input power terminals.

Step 4. Once the drive has been serviced, reattach the drive's cover.

Step 5. Reapply input power to the drive.

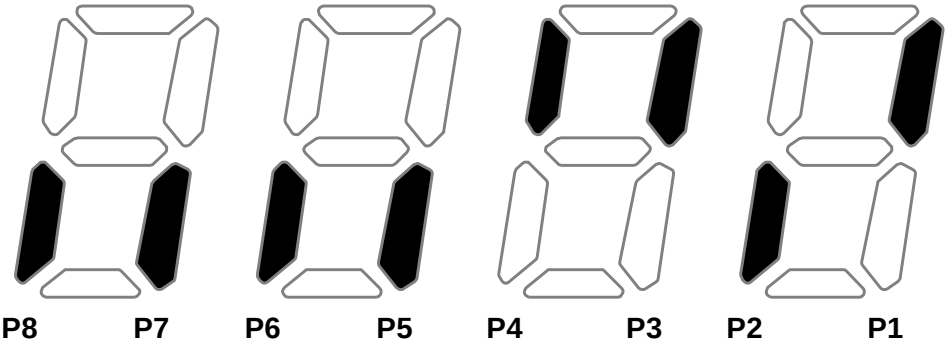
9.2 Determining Drive Status Using the STP/FLT LED

The STP/FLT LED can be used to determine at a quick glance the status of the drive. If the drive is stopped, but not faulted, this LED will be illuminated solid. If the drive is running, this LED will be off. If this LED is flashing, then this indicates that the drive is faulted thus requiring attention. Please refer to figure 9.1.

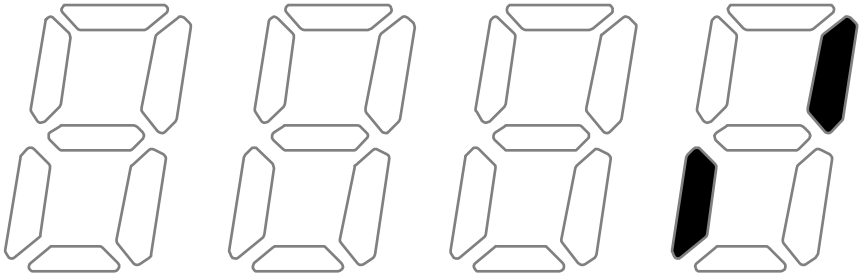
9.3 Monitoring Drive Status Using the Display Parameters

The Display Group has multiple parameters that can be utilized for monitoring the status of the drive and are useful for diagnosing certain situations. Chapter 6 describes how to display these parameters.

If the drive is being operated from the terminal strip, it is useful to monitor the status of the digital inputs to determine operational problems. The digital input status can be monitored by displaying parameter d7. The below describes the details of understanding the status of each of the digital inputs (labeled P1 ~ P8 on the control board terminal strip). In this example, P1, P3, and P4 are “ON” and P2, P5, P6, P7, and P8 are “OFF”.



If the application is using digital outputs to reflect the internal status of the drive, these can be monitored using parameter d8. The below describes the details of understanding the status of each of the digital outputs (labeled MO for the open collector output and 3A/3B/3C for the relay output on the control board terminal strip). In this example, the multi-function output MO is “ON” and the multi-function relay is “OFF” (note that the indication for the multi-function relay is an indication of whether or not the relay coil is energized).



9.4 Reviewing Fault Status of the Drive

As noted in Chapter 6, the Display Group has an entry that designates if there is an active fault and will display the fault code associated with that fault. The fault codes are described later in this chapter. While displaying the fault code within the Display Group, you can press the enter key to display the frequency the drive was running at when the fault occurred. By pressing the up arrow one time, you can display the current the drive detected when the fault occurred. By pressing the up arrow again, you will display the drive status when the fault occurred.

Function Group 2 (H parameters) also contains the current fault along with a history of the previous 4 faults. These faults are located at parameters H1, H2, H3, H4, and H5. As with the fault memory in the Display Group, you can subsequently display the frequency, current, and status for each of these faults using the same procedure outlined in Chapter 6.

9.5 Fault Codes

Fault codes indicate conditions within the drive that require immediate attention. The drive responds to a fault by initiating a coast-to-stop sequence and turning off the power to the motor.

The integral keypad provides visual notification of a fault condition by displaying the following:

- Fault code on the display. (See table 9.1 for the fault code descriptions.)
- Flashing STP/FLT LED

9.5.1 Manually Clearing Faults

Step 1. Note the code of the fault condition on the display.

Step 2. Address the condition that caused the fault. Refer to table 9.1 for a description of the fault and corrective actions. The cause must be corrected before the fault can be cleared.

Step 3. After corrective action has been taken, clear the fault and reset the drive.

9.5.2 Automatically Clearing Faults (Auto Restart Feature)

The Auto Restart feature provides the ability for the drive to automatically perform a fault reset followed by a start attempt without user or application intervention. This allows remote operation. This feature can only be used for faults that are auto-resettable.

When this type of fault occurs, and H26 (Auto Restart) is set to a value greater than 0, a user-configurable timer, H27 (Retry Delay) begins. When the timer reaches zero, the drive attempts to automatically reset the fault. If the condition that caused the fault is no longer present, the fault will be reset and the drive will be restarted.

9.5.3 Fault Descriptions

Table 9.1 – Fault Descriptions

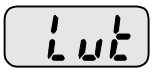
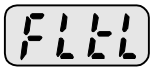
Fault Code/ Display	Fault	Descriptions
	Overcurrent	The drive diables when the output current is detected at a level higher than the inverter rated current.
	Ground fault current	The drive disables when a ground fault occurs and the ground fault current is greater than the internal setting value of the inverter.
	Inverter Overload	The drive disables its output when the output current of the inverter is greater than the rated level.
	Overload trip	The drive disables if the output current of the inverter is at 150% of the inverter rated current for more than the current limit time (1 min).
	Inverter overheat	The drive disables if the heat sink overheats due to a damaged cooling fan or a blockage in the cooling fan by detecting the temperature of the heat sink.
	Output Phase loss	The drive disables its output when one or more of the output (U, V, W) phases is open. The drive detects the output current to check the output phase loss.
	Over voltage	The drive disables its output if the DC bus voltage increases above the bus overvoltage threshold. This fault can also occur due to a surge voltage generated at the input terminals.
	Low voltage	The drive disables its output if the DC bus voltage is less than the undervoltage threshold because insufficient torque or overheating of the motor can occur when the input voltage of the drive is too low.
	Electronic Thermal	The internal electronic thermal of the drive determines the motor heat. If the motor is overloaded the inverter disables the output. The drive cannot protect the motor when controlling a motor having more than 4 poles or multiple motors.
	Input phase loss	Drive output is disabled when one of the input phases (R, S, T) is open.
	Self-diagnostic malfunction	Displayed when IGBT damage, output phase short, output phase ground fault or output phase open occurs.

Table 9.1 – Fault Descriptions

EEP	Parameter save error	Displayed when user-modified parameters fail to be stored into memory.
H/W	Inverter hardware fault	Displayed when an error occurs in the control circuitry of the drive.
Err	Communication Error	Displayed when the drive cannot communicate with the keypad.
rErr	Remote keypad communication error	Displayed when drive and remote keypad do not communicate with each other. This fault does not stop Inverter operation.
COM	Keypad error	Displayed after drive resets keypad upon a keypad error and the error remains for a predetermined time.
FAn	Cooling fan fault	Displayed when a fault condition occurs in the drive cooling fan.
EST	Instant Cut Off	Used for the immediate stop of the drive. The inverter instantly disables the output when the EST terminal is actuated.
		ATTENTION: The inverter resumes regular operation when turning off the EST terminal while either the FX or the RX terminal is ON.
EtA	External fault A contact input	When multi-function input terminal (t1-t8) is set to 18 {External fault signal input: A (Normal Open Contact)}, the inverter disables its output.
Etb	External fault B contact input	When multi-function input terminal (t1-t8) is set to 19 {External fault signal input: B (Normally Closed Contact)}, the drive disables its output.
_ _ L	Operating method when the frequency command is lost	When drive operation is set via an Analog input (0-10V or 0-20mA input) or option (RS485) and the signal is lost,the drive responds according to the method set in t62 (Operating method when the frequency reference is lost).
nTC	NTC open	When NTC connection is lost, output is disabled.

9.6 Fault Correction

Use table 9.2 to troubleshoot the drive. If you cannot resolve the problem using this table, contact Baldor-Reliance.

Table 9.2 – Corrective Actions

Keypad Display	Fault	Cause	Remedy
	Overcurrent	• Accel/Decel time is too short compared to the inertia of the load.	• Increase the Accel/Decel time.
		• Load is greater than the drive rating.	• Replace the inverter with appropriate capacity
		• Inverter enabled when the motor is rotating.	• Resume operation after stopping the motor or use H22 (Speed search).
		• Output short circuit or ground fault has occurred.	• Check output wiring.
		• Mechanical brake on the motor is operating incorrectly.	• Check the mechanical brake
		ATTENTION: When an overcurrent fault occurs, the cause of the fault must be corrected before operation is restarted. Failure to observe this precaution could result in damage to, or destruction of, the IGBT.	
	Ground fault current	• Ground fault has occurred in the output wiring of the drive.	• Check the wiring between the drive and the motor.
		• The insulation of the motor is damaged.	• Replace the motor.
	Inverter Overload	• Load is greater than the drive rating.	• Upgrade the capacity of motor and drive or reduce the load.
	Overload trip	• Torque boost scale is set too large.	• Reduce torque boost scale.

Table 9.2 – Corrective Actions

OHt	Inverter overheat	• Cooling system has problems.	• Check for foreign substances clogged in the heat sink.
		• Cooling fan has failed.	• Replace the old cooling fan with a new one.
		• Ambient temperature is too high.	• Keep ambient temperature under 50 degrees C.
POt	Output Phase loss	• Faulty contact in output contactor.	• Replace or repair output contactor.
		• Faulty output wiring	• Check output wiring.
FAn	Cooling Fan Fault	• An foreign substance is clogged in a ventilating slot.	• Check the ventilating slot and remove the clogged substances.
		• Cooling fan has failed.	• Replace the cooling fan.
Out	Over voltage	• Decel time is too short for the inertia of the load.	• Increase the Decel time.
		• Regenerative load is connected to the drive.	• Use Dynamic Brake Unit.
		• Line voltage is too high.	• Check to see if line voltage exceeds the rating.
Lut	Low voltage	• Line voltage is low.	• Check to see if line voltage is below the rating.
		• Load larger than line capacity is connected to line (ex: welding machine, motor with high starting current connected to the commercial line).	• Check the incoming AC line. Adjust the line capacity corresponding to the load.
		• Faulty contactor on the input of the inverter.	• Change contactor.

Table 9.2 – Corrective Actions

ETH	Electronic Thermal	• Motor has overheated.	• Reduce load and/or duty cycle.
		• Load is greater than inverter rating.	• Change drive with higher capacity.
		• ETH level is set too low.	• Adjust ETH level to an appropriate level.
		• Drive capacity is incorrectly selected.	• Select correct drive capacity.
ETA	External fault A contact input	• The terminal set to “18 (External fault-A)” or “19 (External fault-B)” in t1-t8 within terminal.	• Eliminate the cause of fault in the circuit connected to external fault terminal.
ETB	External fault B contact input		
_ _L	Operating method when the frequency command is lost	• No frequency command is applied to V1 and I.	• Check the wiring of V1 and I and frequency reference level.
rErr	Remote keypad communication error	• Communication error between drive keypad and remote keypad.	• Check for connection of communication line and connector.
EEP HWT Err COM nTC EEP: Parameter save error HWT: Hardware fault Err: Communication error COM: Keypad error NTC: NTC error			• Call Baldor-Reliance for assistance.

9.7 Overload Protection

IOLT : IOLT(inverter Overload Trip) protection is activated at 150% of the inverter rated current for 1 minute and greater.

OLT : OLT is selected when F56 is set to 1 and activated at 200% of F57[Motor rated current] for 60 sec in F58. This can be programmable.

APPENDIX A
Technical Specifications

Appendix A provides technical specifications for the VS1MD drive..

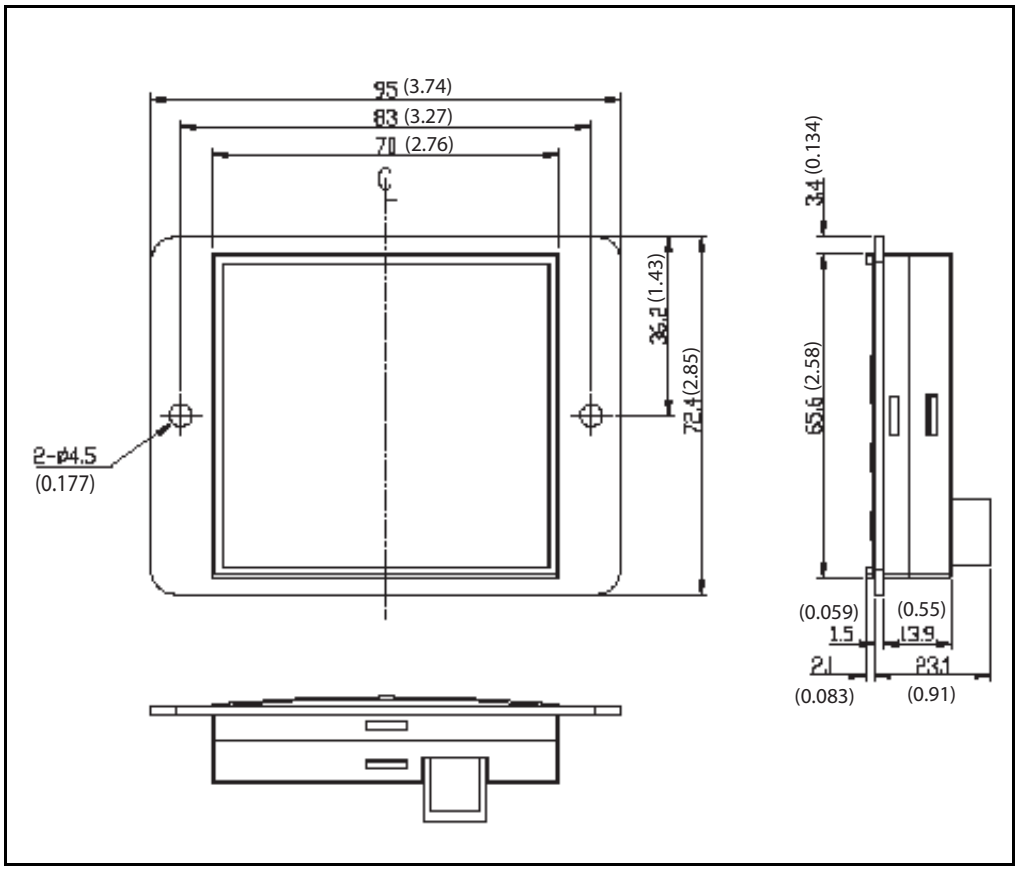
Environment	
Altitude	1000 m, (3300 ft.), max without derating
Vibration	5.9m/sec^2, (0.6G)
Ambient Operating Temperature	-10º to 50º C, (14 to 122º F)
Storage Temperature	-20º to 65º C, (-4 to 149º F)
Relative Humidity	90%, non-condensing
Cooling Method	Natural Convection / Forced Air Cooling, (Fan)
Atmosphere	**Important:** The drive must not be installed in an area exposed to volatile or corrosive gas, vapors or dust. If the drive will be stored for a time before installation, it must be stored in an area where it will not be exposed to a corrosive atmosphere.
Control	
Control Method	V/Hz, Sensorless Vector
Speed Reference Resolution	Digital command: 0.01Hz Analog signal command: 0.06 Hz, (Max freq., 60 Hz)
Frequency Accuracy	Digital command: 0.01% of Max output freq. Analog signal command: 0.1% of Max output freq.
V/Hz Curve	Linear, Squared, User custom V/Hz.
Terminal Strip Input	
P1 – P8	Multi-function programmable inputs, T/M 1-8
CM	Common terminal

V1, Voltage Analog Input	-12 - +12 VDC max.
I, Analog Current Input	0 – 20 mA, Internal resistor, 250 Ohm
Terminal Strip Outputs	
VR, Reference Power Supply	12 VDC Output, 10mA max. Potentiometer 1 – 5 Kohm
AM, Multi-function Analog Output Signal	11 VDC, 100 mA max.
MO, Multi-function Terminal, Open Collector	<26 VDC, 100 mA
MG, External Power Supply Ground Terminal	
24, Power Supply	100 mA max output current
3A 3B 3C, common	Multi-function Relay Output Terminals: Max. 250 VAC, 1A 30 VDC, 1A

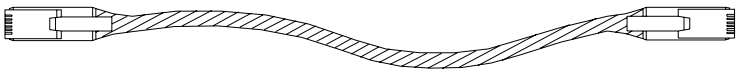
APPENDIX B
Options & Kits

B.1 Remote Option

B.1.1 Remote Keypad



B.1.2 Remote Cable (2M,3M,5M)

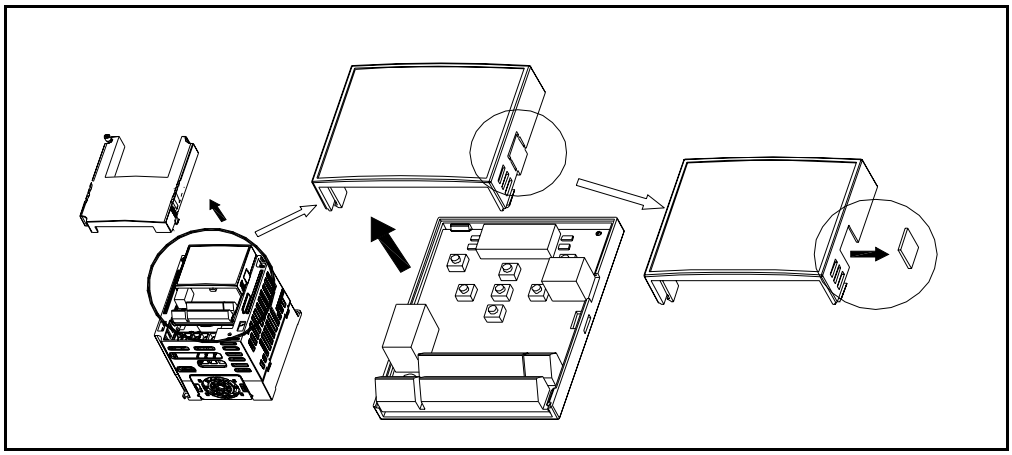


B.1.3 Remote Keypad and Cable Model Numbers

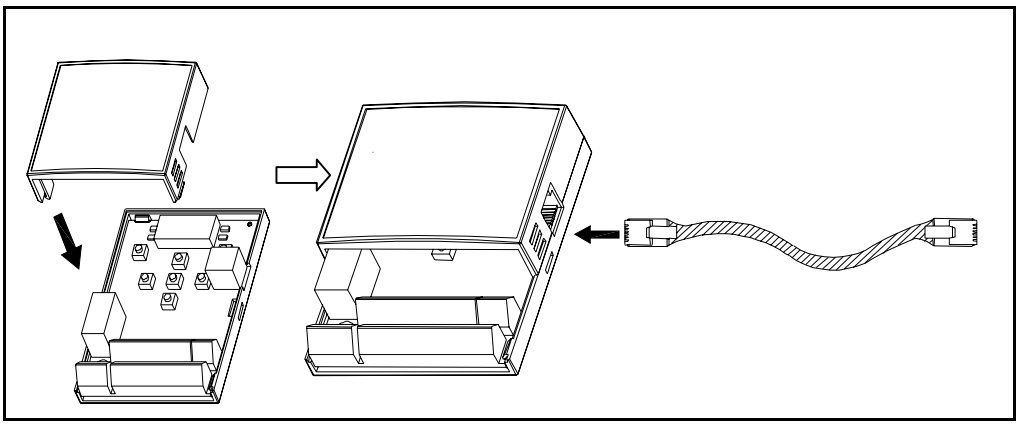
Model number	Description
VS1MD-RKEY2	INV - Remote - 2 meter length (6.5 ft)
VS1MD-RKEY3	INV - Remote - 2 meter length (6.5 ft)
VS1MD-RKEY5	INV - Remote - 2 meter length (6.5 ft)

B.1.4 Installation

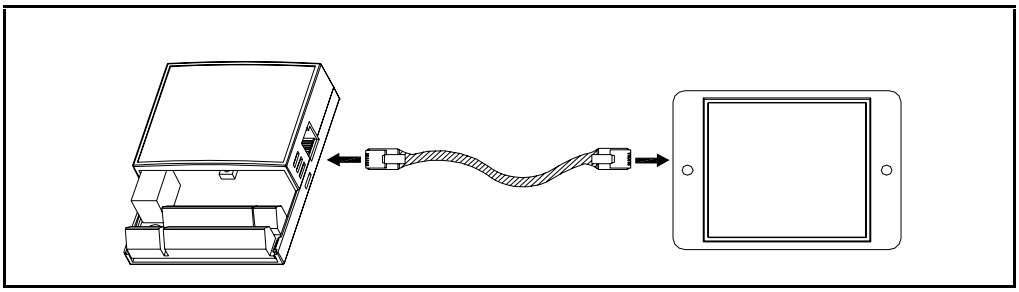
Step 1. Take off the top cover of the I/O board kit and remove the hole cover to connect remote cable on the side.



Step 2. Attach the top cover of the I/O board kit and connect the remote cable as shown below.



Step 3. Connect the other side of the remote cable to the remote keypad as shown below.



ATTENTION: Without Parameter Read (H91), Parameter Write (H92) is not available since the Remote memory is empty when the Remote keypad is first used.

ATTENTION: Do not use the remote cable other than those provided in the kit. Improper operation may occur due to noise and /or voltage drop issues.

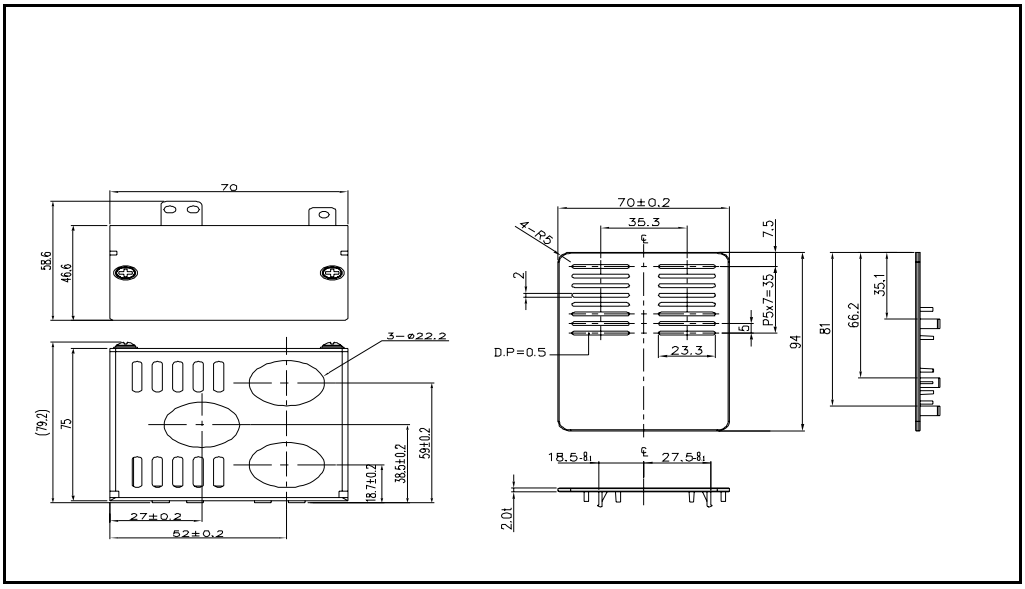
ATTENTION: Check for disconnection of the communication cable and/or poor cable connection if ì----ì is displayed on the 7-segment display of the Remote keypad.

B.2 Conduit Kit

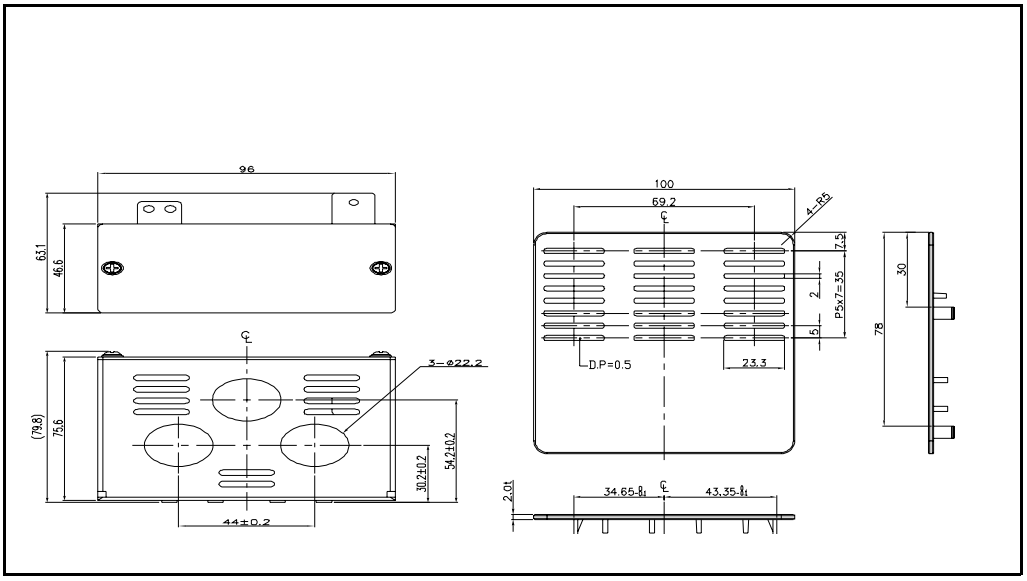
B.2.1 Conduit Kit Model Numbers

Conduit Kit	Model
VS1MD-NM1A	0.5 and 1.0 HP (0.4 and 0.75 kW)
VS1MD-NM1B	2.0 HP (1.5 kW)
VS1MD-NM1C	3.0 and 5.0 HP (2.2 and 4.0 kW)
VS1MD-NM1D	7.5 and 10.0 HP (5.5 and 7.5 kW)

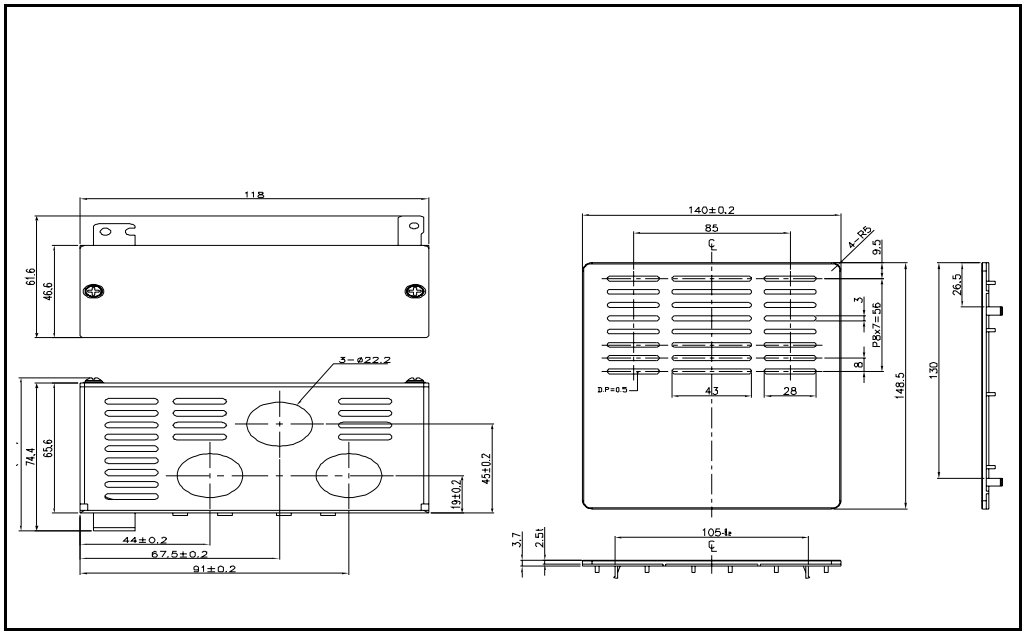
B.2.2 VS1MD-NM1A



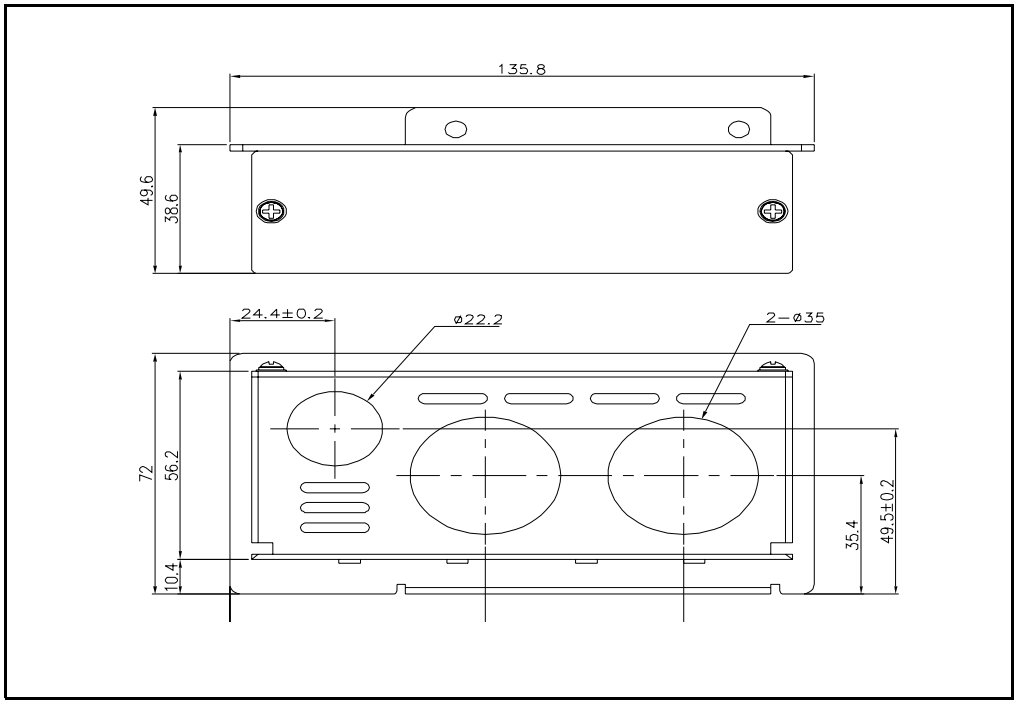
B.2.3 VS2MD-NM1B



B.2.4 VS1MD-NM1C

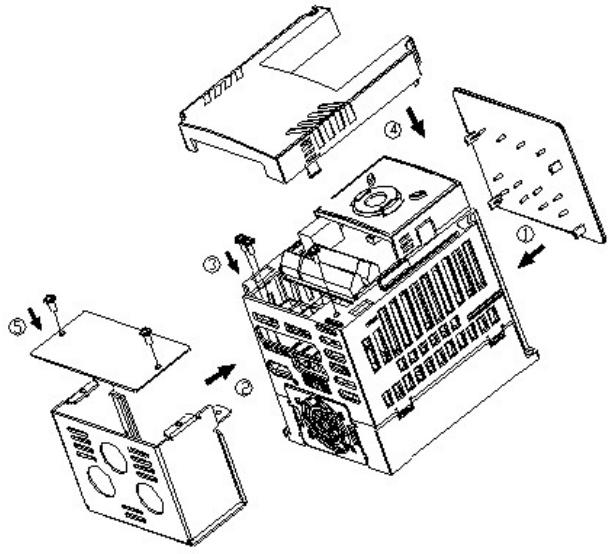


B.2.5 VS1MD-NM1D

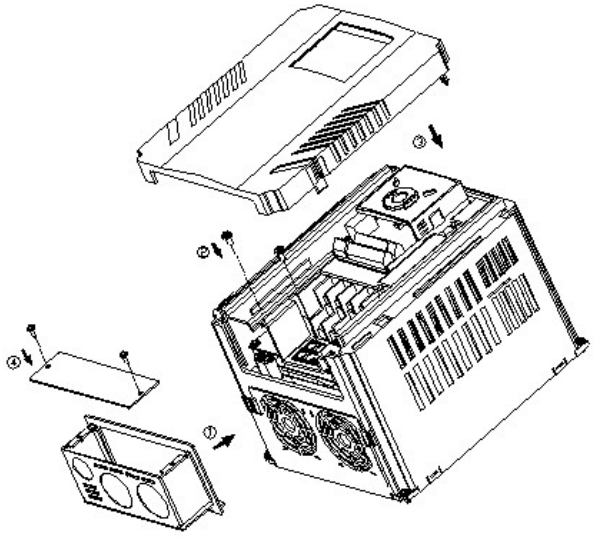


B.2.6 Installation

B.2.6.1 VS1MD-NM1A, VS1MD-NM1B, VS1MD-NM1C



B.2.6.2 VS1MD-NM1D



B.2.7 Conduit Hole Size

Conduit Kit	Conduit hole for control terminal inches (mm)	Size of the Conduit (Metric)
	Conduit hold for power terminal inches (mm)	
VS1MD-NM1A	0.87 (22.2)	1/2 (16)
	0.87 (22.2)	1/2 (16)
VS1MD-NM1B	0.87 (22.2)	1/2 (16)
	0.87 (22.2)	1/2 (16)
VS1MD-NM1C	0.87 (22.2)	1/2 (16)
	0.87 (22.2)	1/2 (16)
VS1MD-NM1D	0.87 (22.2)	1/2 (16)
	1.38 (35.0)	1/1 (27)

NOTE: Choose the proper size of the UL recognized Locknut and Bushing corresponding to size of the Conduit in use.

B.3 Braking Resistor

Input Voltage	Inverter capacity HP (kW)	100 % braking		150% braking	
		Ω	W[1]	Ω	W[1]
230	0.5 (0.4)	400	50	300	100
	1.0 (0.75)	200	100	150	150
	2.0 (1.5)	100	200	60	300
	3.0 (2.2)	60	300	50	400
	5.0 (3.7)	40	500	33	600
	7.5 (5.5)	30	700	20	800
	10.0 (7.5)	20	1000	15	1200
460	0.5 (0.4)	1800	50	1200	100
	1.0 (0.75)	900	100	600	150
	2.0 (1.5)	450	200	300	300
	3.0 (2.2)	300	300	200	400
	5.0 (3.7)	200	500	130	600
	7.5 (5.5)	120	700	85	1000
	10.0 (7.5)	90	1000	60	1200

[1]The wattage is based on Enable duty (%ED) 5% with continuous braking time 15 sec.

APPENDIX C
RS485 Protocol

C.1 Introduction

The drive can be controlled and monitored by the program of aPLC or other master module.

Drives or other slave devices may be connected in a multi-drop fashion on the RS-485 network and may be monitored or controlled by a single PLC or PC. Parameters can be set and changed through the PLC or PC.

C.1.1 Features

The VS1MD can easily be utilized for factory automation applications because operation and monitoring are available by the user's program.

- Parameter change and monitoring is available via computer. (Ex: Accel/Decel time, Freq. Command etc.)
- RS484 Interface:

1. Allows the drive to communicate with any other computers or PLC's.
2. Allows connection of up to 31 drives with multi-drop link network.
3. Inherent noise immune design.

Users can use readily available RS232-485 converters. The specifications of converters depend on the manufacturers.

C.1.2 Before Installation

ATTENTION: Before installation and operation, this manual should be read thoroughly. Failure to observe this precaution could result in personal injury or damage to the equipment.

C.2 Specifications

C.2.1 Performance Specifications

Item	Specification
Communication method	RS485
Transmission form	Bus method, Multi drop Link System
Applicable inverter	VS1MD series
Converter	RS232 converter
Connectable drives	Max 31
Transmission distance	Max. 1,200m (Within 700m Recommend)

C.2.2 Hardware Specifications

Item	Specification
Installation	Use S+, S- terminals on control terminal block
Power supply	Use Insulated power from the inverter power supply

C.2.3 Communication Specifications

Item	Specification
Communication speed	19,200/9,600/4,800/2,400/1,200 bps selectable
Control procedure	Asynchronous communication system
Communication system	Half duplex system
Character system	ASCII (8 bit)
Stop bit length	Modbus-RTU: 2 bit LS Bus: 1 bit
Sum check	2 byte
Parity check	None

C.3 Installation

C.3.1 Connecting the Communication Line

Step 1. Connect the RS485 communication line to the inverter's (S+), (S-) terminals of the control terminals.

Step 2. Check the connection and turn ON the inverter.

Step 3. If the communication line is connected correctly, set the communication-related parameters as follows:

- P38 [Drive mode]: 3(RS485)
- P40 [Freq. mode]: 7(RS485)
- t60 [Inv. Number]: 1 to 250 (If multiple inverters are connected, be sure to use different numbers for each inverter)
- t61 [Baud-rate]: 3 (9,600 bps as Factory default)
- t62 [Lost Mode]: 0 - No action (Factory default)
- t63 [Time-Out]: 1.0 sec (Factory default)
- t59 [Comm. Prot]: 0 - Modbus-RTU

C.3.2 Computer and Inverter Connection

The maximum number of drives that can be connected is 31.

The maximum length of communication line is 1200m. To ensure stable communication, keep the length to less than 700m.

C.4 Operation

C.4.1 Operating steps

Step 1. Check whether the computer and the inverter are connected correctly.

Step 2. Turn ON the inverter. But do not connect the load until stable communication between the computer and the inverter is verified.

Step 3. Start the operating program for the inverter from the computer.

Step 4. Operate the inverter using the operating program for the inverter.

Step 5. Refer to Chapter 9: Troubleshooting if the communication is not operating.

C.5 Communication Protocol (MODBUS-RTU)

Use Modbus-RTU protocol (Open protocol).

Computer or other hosts can be Master and inverters Slave. Inverter responds to Read/Write command from Master.

Table C.1 – Supported function codes

Function code	Description
0x03	Read Hold Register
0x04	Read Input Register
0x06	Preset Single Register
0x10	Preset Multiple Register

Table C.2 – Exception codes

Function code		Description
0x01		ILLEGAL FUNCTION
0x02		ILLEGAL DATA ADDRESS
0x03		ILLEGAL DATA VALUE
0x06		SLAVE DEVICE BUSY
User define	0x14	1.Write Disable (Address 0x0004 value is 0). 2.Read Only or Not Program during Running.

C.6 Communication Protocol (LS Bus)

C.6.1 Basic Format

Command message (Request):

ENQ	Drive No.	CMD	Data	SUM	EOT
1 byte	2 bytes	1 byte	n bytes	2 bytes	1 byte

Normal response (Acknowledge Response):

ACK	Drive No.	CMD	Data	SUM	EOT
1 byte	2 bytes	1 byte	n * 4 bytes	2 bytes	1 byte

Negative response (Negative Acknowledge Response):

NAK	Drive No.	CMD	Error code	SUM	EOT
1 byte	2 bytes	1 byte	2 bytes	2 bytes	1 byte

Description:

Request starts with “ENQ” and ends with “EOT”.

Acknowledge Response starts with “ACK” and ends with “EOT”.

Negative Acknowledge Response starts with ”NAK” and ends with “EOT”.

“Drive Number” is the number of the drive and is indicated in 2 byte ASCII-HEX.

(ASCII-HEX: Hexadecimal consists of ‘0’ to ‘9’, ‘A’ to ‘F)

CMD: Capital letter

Character	ASCII-HEX	Command
R	52h	Read
W	57h	Write
X	58h	Request for monitoring
Y	59h	Action for monitoring

Data: ASCII-HEX

Example: when data value is 3000: 3000 (dec) ‘0’ ‘B’ ‘B’ ‘8’h 30h 42h 42h 38h

Error code: ASCII (20h to 7Fh)

Receive/Send buffer size: Receive= 39 byte, Send=44 byte

Monitor register buffer: 8 Word

SUM: to check the communication error

SUM= ASCII-HEX format of lower 8 bit of (Drive No. + CMD + DATA)

Example: Command Message (Request) to read one address from address “3000”

ENQ	Drive No	CMD	Address	Number of address to read	SUM	EOT
05h	“01”	“R”	“3000”	“1”	“A7”	04h
1 byte	2 bytes	1 byte	4 bytes	1 byte	2	1

SUM = ‘0’ + ‘1’ + ’R’ + ‘3’ + ‘0’ + ‘0’ + ‘0’ + ‘1’

=30h + 31h + 52h + 33h + 30h + 30h + 30h + 31h

= 1A7h (Control values such as ENQ/ACK/NAK are excluded.)

C.6.2 Detail Communication Protocol

C.6.2.1 Request for Read:

Request to read successive 'N' numbers of WORD from address "XXXX"**.**

ENQ	Drive No	CMD	Address	Number of address to read	SUM	EOT
05h	"01" to	"R"	"XXXX	"1" to "8" = n	"XX"	04h
1 byte	2 bytes	1 byte	4 bytes	1 byte	2	1

Total bytes = 12

Note: Quotation marks (" ") indicate character.

C.6.2.2 Acknowledge Response:

ACK	Drive No	CMD	Data	SUM	EOT
06h	"01" to "1F"	"R"	"XXXX"	"XX"	04h
1 byte	2 bytes	1 byte	N * 4 bytes	2 byte	1 byte

Total bytes= 7 + n * 4 = Max 39

C.6.2.3 Negative Acknowledge Response:

NAK	Drive No	CMD	Error code	SUM	EOT
15h	"01" to "1F"	"R"	"**"	"XX"	04h
1 byte	2 bytes	1 byte	2 bytes	2 bytes	1 byte

Total bytes = 9

C.6.2.4 Request for Write:

ENQ	Drive No	CMD	Address	Number of address to read	Data	SUM	EOT
05h	"01" to	"W"	"XXXX"	"1" to "8" = n	"XXXX	"XX"	04h
1 byte	2 bytes	1 byte	4 bytes	1 byte	n*4	2	1

Total bytes = 12 + n * 4 = Max 44

C.6.2.5 Acknowledge Response:

ACK	Drive No	CMD	Data	SUM	EOT
06h	“01” to “1F”	“W”	“XXXX…”	“XX”	04h
1:byte	2:bytes	1:byte	n * 4 bytes	2 bytes	1

Total bytes = 7 + n * 4 = Max 39

Note: When Request for Write and Acknowledge Response is exchanged between PC and Inverter for the first time, previous data is returned. From subsequent transmissions, the current data will be returned.

C.6.2.6 Negative Response:

NAK	Drive No	CMD	Error code	SUM	EOT
15h	“01” to “1F”	“W”	“**”	“XX”	04h
1 byte	2 bytes	1 byte	2 bytes	2 bytes	1

Total bytes = 9

C.6.2.7 Request for Monitor Register

This is useful when constant parameter monitoring and data updates are required.

Request for Register of ‘n’ numbers of Address (not consecutive)

ENQ	Drive No	CMD	Number of address to read	Address	SUM	EOT
05h	“01” to	“X”	“1” to “8”=n	“XXXX	“XX”	04h
1 byte	2 bytes	1	1 byte	n * 4	2 byte	1

Total bytes = 8 + n * 4 = Max 40

C.6.2.8 Acknowledge Response:

ACK	Drive No	CMD	SUM	EOT
06h	“01” to “1F”	“X”	“XX”	04h
1 byte	2 bytes	1 byte	2 bytes	1 byte

Total bytes = 7

C.6.2.9 Negative Acknowledge Response:

NAK	Drive No	CMD	Error code	SUM	EOT
15h	“01” to “1F”	“X”	“**”	“XX”	04h
1 byte	2 bytes	1 byte	2 bytes	2 bytes	1 byte

Total bytes = 9

C.6.2.10 Action Request for Monitor Register:

Request to read address registered by monitor register.

ENQ	Drive No	CMD	SUM	EOT
05h	“01” to “1F”	“Y”	“XX”	04h
1 byte	2 bytes	1 byte	2 bytes	1 byte

Total bytes = 7

C.6.2.11Acknowledge Response:

ACK	Drive No	CMD	Data	SUM	EOT
06h	“01” to “1F”	“Y”	“XXXX…”	“XX”	04h
1 byte	2 bytes	1 byte	n * 4 bytes	2 bytes	1 byte

Total bytes = 7 + n * 4 = Max 39

C.6.2.12Negative Response:

NAK	Drive No	CMD	Error code	SUM	EOT
15h	“01” to “1F”	“Y”	“**”	“XX”	04h
1 byte	2 bytes	1 byte	2 bytes	2 bytes	1 byte

Total bytes = 9

C.6.2.13Error codes

Error code	Description
“IF”	When master is sending codes other than Function code (R, W, X,
“IA”	When parameter address does not exist
“ID”	When Data value exceeds its permissible range during ‘W’ (Write).
“WM”	When the specific parameters cannot be written during ‘W’ (Write). (For example, in the case of Read Only, Write disabled during Run)
“FE”	When frame size of specific function is not correct and Checksum

C.7 Troubleshooting

Refer to Troubleshooting when RS 485 communication error occurs.

Check Points	Corrective Measures
Is power provided to the converter?	Provide electric power to the converter.
Are the connections between converter and computer correct?	Refer to the converter manual.
Is Master not polling?	Verify the Master is polling the drive.
Is baud rate of computer and drive set correctly?	Set the correct value.
Is the data format of user program correct?	Set data formats equal between drive and computer.
Is the connection between the converter and the communication card correct?	Check for the correct wiring.

C.8 Miscellaneous

ASCII Code List

Character	Hex	Character	Hex	Character	Hex	Character	Hex	Character	Hex
A	41	a	61	0	30	:	3A	DLE	10
B	42	b	62	1	31	;	3B	EM	19
C	43	c	63	2	32	<	3C	ACK	06
D	44	d	64	3	33	=	3D	ENQ	05
E	45	e	65	4	34	>		EOT	04
F	46	f	66	5	35	?	3E	ESC	1B
G	47	g	67	6	36	@	3F	ETB	17
H	48	h	68	7	37	[	40	ETX	03
I	49	i	69	8	38	\	5B	FF	0C
J	4A	J	6A	9	39	]	5C	FS	1C
K	4B	k	6B	space	20		5D	GS	1D
L	4C	l	6C	!	21		5E	HT	09
M	4D	m	6D	"	22		5F	LF	0A
N	4E	n	6E	#	23	{	60	NAK	15
O	4F	o	6F	$	24	|	7B	NUL	00
P	50	p	70	%	25	}	7C	RS	1E
Q	51	q	71	&	26	to	7D	S1	0F
R	52	r	72	'	27	BEL	7E	SO	0E
S	53	s	73	(	28	BS	07	SOH	01
T	54	t	74	)	29	CAN	08	STX	02
U	55	u	75	*	2A	CR	18	SUB	1A
V	56	v	76	+	2B	DC1	0D	SYN	16
W	57	w	77	,	2C	DC2	11	US	1F
X	58	x	78	-	2D	DC3	12	VT	0B
Y	59	y	79	.	2E	DC4	13		
Z	5A	z	7A	/	2F	DEL	14		
							7F		

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